

ACTA CHIRURGICA SCANDINAVICA



SUB TITULO

NORDISKT MEDICINSKT ARKIV

CONDIDIT MDCCCLXIX AXEL KEY



REDACTORES:

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Aarhus

J. HOLST

Oslo

EINAR KEY

Stockholm

S. KJÆRGAARD · F. LANGENSKIÖLD

Köbenhavn

Helsingfors

G. PETRÉN

Lund

CARL SEMB

Oslo

G. THORODDSEN

Reykjavik

REDIGENDA CURAVIT

EINAR KEY

Stockholm

ACCEDENTE

J. HELLSTRÖM

Stockholm

COLLABORANT:

IN DANIA: O. Chievitz, Fabricius-Möller, J. Foged, J. Ipsen, E. Dahl-Iversen, L. Kraft, A. Lendorf, N. Aage Nielsen, H. Retlev-Abrahamssen, C. Wessel.

IN FINNIA: H. Elving, M. Hämäläinen, T. Kalima, L. Lindström, P. E. A. Nylander, A. J. Palmén, V. Seiro.

IN NORVEGIA: N. Baeker-Grøndahl, A. Berg, A. Brekke, P. Bull, H. F. H. Harbitz, R. Ingebrigtsen, E. Platon, A. Sunde.

IN SUECIA: F. Baner, G. Bohmansson, C. Crafoord, K. H. Giertz, O. Hultén, S. Johansson, N. Liedberg, E. Ljunggren, G. Nyström, H. Olivecrona, I. Palmer, E. Perman, S. Rödén, O. Schuberth, J. P. Strömbeck, G. Söderlund, A. Troell, H. Waldenström, J. Waldenström, A. Westerborn, H. Wulff, J. Åkerman.

STOCKHOLM 1945

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From the Surgical Department D of Rigshospitalet, Copenhagen.
(Chief Surgeon: Professor S. KJÆRGAARD.)

On Urinary Lithiasis in Childhood.

By

C. C. WINKEL SMITH, M. D.

In connexion with the compilation of a material of urinary calculi in children treated at Copenhagen hospitals since 1929, a review of the literature revealed that a more exhaustive survey of the subject probably would be justifiable. From Europe no such survey seems to exist, and since COLLINS published his report in 1924 a review of the subject does not appear to have come from America either, so even in his paper recent years' contribution to the subject is lacking.

The following is an attempt at forming a comprehensive view of the clinical features of urinary lithiasis during childhood on the basis of especially the more recent literature, taking special regard to the purely practical question as to whether the indications for treatment, primarily the operative indications, in case of the adult may be directly applied to the child.

Incidence.

In Europe as well as in America urinary lithiasis in children is considered to be an uncommon disease. In FEER's "Kinderkrankheiten" 1942 NOEGGERATH thus points out that calculi in the urinary tract of children occur but rarely and are of insignificant clinical importance. On the basis of his investigations into the incidence of lithiasis in Sweden, HELLSTRÖM arrived at the same result, finding that out of 750 cases of urinary calculi observed during the period 1911—1934 only 5 were children below the age of 10, and that out of 40 000 patients treated at Göteborgs Barnsjukhus (The Gothenburg Children's Hospital) during the years

from 1911—1930 only 17 cases were classed under the diagnosis of concretion of the urinary tract and only 9 of them were absolutely certain.

In the case of the adult lithiasis we are aware of the fact that the incidence of calculi in the urinary tract is dependent on certain external conditions. There are thus localities and countries where lithiasis is essentially endemic like Russia, Asia, especially China, and the Balkans. The factor of time also plays in, periods of frequency alternating with infrequency.

According to the literature the same thing seems to apply to calculi in childhood, and it is strange to see to what great extent the lesion appears to have alternated between the countries and between the various periods within the same country.

In France e. g. CIVIALE reported that from the middle of the last century not less than 45 per cent of 5 900 cases of stone occurred in children below the age of 15. By the post-mortem study of 600 children COMBY found stones in no less than 100.

In England, THOMPSON during approximately the same period found that 1 028 of 1 827 patients operated upon for bladder stones were below the age of 17, and an English statistical report by PROUT reveals that 40 per cent of all patients with urinary calculi were below 10 years.

And lastly, from Hungary v. BOKAY about the turn of the century reported a material of 1836 cases of calculi in children.

In contrast to the above, recent literature from the same countries indicates that lithiasis in children is far from being a frequent lesion. In France, RAFIN reporting 2 cases of his own in 1911, could only collect 39 cases by inquiries of his colleagues, and part of them were only demonstrated on autopsy. CHARVIN only obtained 45 cases. The reports of the last 20—30 years have been scanty and mostly in the form of case histories (ANDRÉ, LEREBoullet, LEPoutRE, NOBECourt). It also appears from a report by MARION from 1934 that at any rate a very small percentage of calculi occurs in childhood, and at the same time PAISSEAU and LAMBLING in "Traité de médecine des enfants" 1934 come to the conclusion that stones in childhood actually are disappearing.

From England too, recent years only have yielded sparse case reports as f. inst. by OLLERENSHAW in 1913, WILES in 1930, and THOMAS & REDDA in 1931. In "Surgery of Childhood" 1926 FRAZER writes that calculi do occur in childhood, without giving the impression of being a particularly common disease, whereas

COLLIS in "Diseases of Infancy and Childhood" in 1938 considers calculi in childhood to be quite a frequent occurrence.

In Germany the clinical literature on lithiasis in childhood is remarkably scarce when considering that on the basis of a large autopsy material from Breslau, PONFICK in 1911 could establish that lithiasis during infancy was surprisingly common in Germany. At the same time and from the same period of time JOSEPH reports 40 cases of calculi in infants below 2 years of age, also demonstrated on autopsy. Nevertheless the more recent contributions consist of case reports (EBERT 1912, KÖNIG 1922, STÖHR 1928, ULMER 1928, DIETRICH 1934, SZENTHE 1939) and in a long report on renal calculi in 1922 ISRAEL only just mentions that calculi may be encountered in children, but does not further discuss the frequency of the lesion. In 1934 NOEGGERATH finally states that he has not met a single case of calculi in children for the last 17 years.

In opposition to the above, DRACHTER in "Chirurgie des Kinderalters" (PFAUNDLER-SCHLOSSMANN) in 1930 points out that lithiasis in childhood is far more common in Germany than the literature lets suppose, a view which also finds its spokesman in DIETRICH.

In North-America lithiasis in childhood does not seem to be particularly common, but does occur from time to time spread all over the States. As a result of 600 autopsies on children in 1913 COLLINS found that calculi are quite a frequent occurrence in early childhood, and a series of large works: THOMAS and TANNER in 1922 with 203 cases, CAMPBELL in 1930 with 30 cases, and KRETSCHMER in 1935 with 21 cases, besides a number of case reports by HILL & STEVENS 1920, THURSFIELD 1921, HINNEMANN 1921, BROWN 1927, BUTTERFIELD 1930, and SCHONFIELD 1935 serves to illustrate the ever increasing interest in the question and indicates that lithiasis in childhood is far from being a rare disease in the U. S. A.

The Scandinavian literature on the subject is sparse. In Denmark individual cases have been reported by HIRSCHSPRUNG and SALOMONSEN. In 1923 CHRISTENSEN reported a material of 16 children with urinary lithiasis from Dronning Louises Børnehospital (Queen Louise's Children's Hospital) from the period 1850—1923, and JOHANNESSEN in his thesis (1926) on pyuria in children reported 4 cases of calculi in children, a couple of which cases also are included in a material published in another connexion by ROVSING.

In Sweden, SVEN JOHANSSON (1921) reported 2 cases of calculi in children (boys) of 10 and 11 and at the same time reviewed the very scanty earlier Swedish literature on the subject. Apart from a single case contained in COLLET's thesis (1919) Norway only seems to be represented by SUNDAL's work on "*Kroniske pyurier hos børn*" (Chronic pyuria in children) from 1935 which includes 4 cases of urinary lithiasis in children.

On the whole the literature of recent years represents the general opinion that lithiasis in childhood does occur, but not often. At the same time, however, it strikes one that the more recent reports repeatedly emphasize that findings of calculi in early life are probably a far more common occurrence than ordinarily assumed, and that a large number of the calculi demonstrated during youth date back from childhood. This view does not, however, seem to prevail in the Scandinavian countries, where lithiasis still appears to be considered a rare and purely sporadic disease of no importance in the daily clinical practice.

Location of the Calculi

As to the location of the calculi the reports reveal considerable divergencies. THOMPSON's 1028 cases were exclusively bladder stones, and among 1836 cases v. BOKAY found 1319 bladder stones, 508 urethral, and only 9 renal stones. In Sweden PERMAN found that during the period 1871—1890 4 children had been operated upon for renal stones and 20 for bladder stones. Among his material of 3 492 cases reported in 1921, 25 per cent of which were children, THOMPSON found 2 962 bladder stones, 409 urethral, and only 5 renal stones. Among 203 patients THOMAS and TANNER reported that 57 per cent were bladder stones and 12 per cent urethral stones, so that no less than 69 per cent of the stones have passed down to the bladder before they are diagnosed. Out of 31 patients CAMPBELL found 23 cases of renal stones, 4 urethral, and 4 bladder stones, and 3 cases of stones of multiple locations. Finally KRETSCHMER reporting 21 cases found 6 renal stones, 3 urethral, and 7 bladder stones. 5 patients had several stones at the same time in the kidney, ureter, or bladder. KRETSCHMER is of the opinion that the rather frequent occurrence of stones of multiple locations is a peculiarity of lithiasis in childhood. His 22.8 per cent quite well correspond to RAFIN's 25 per cent of multiple stones in the urinary tract out of 39 cases. In this respect

lithiasis in children differs clinically from the adult lithiasis, where multiple calculi are less common.

Judging from the literature one must be prepared to encounter more cases of multiple calculi in several organs at the same time in children than in adults. Furthermore, quite special attention seems to be due to the lower urinary tract (bladder and urethra) where up to 60—70 per cent of the calculi can be expected to be found during childhood.

Age.

Stones in the urinary tract appear to occur all through childhood, even from infancy. LANGENBECK found a bladder stone in a 6 months fetus, and RAYER reported 2 cases of stones in fetuses of 6 and 8 months. BRENDDEL found stones in 2 babies who had died 2 days after birth, and further RAYER has reported 3 cases of stones in newborn infants from 1—8 days old and 5 cases in infants from 3—12 months. From autopsy materials both JOSEPH and PONFICK found that lithiasis in childhood is most common during infancy up to the age of 2. In RAFIN's material of 39 children, however, all ages were represented, 5 between 1—5 years, and the majority between 5—10, whereas THOMAS' and TANNER's cases are evenly distributed over all ages with an average age of 7.8 years. KRETSCHMER's 21 cases also showed an even distribution, while CAMPBELL arrived at an average of 8 years in a material of 13 living children.

Thus opinions as to the time of the occurrence of lithiasis in childhood apparently are divergent, but actually no certain conclusion can be drawn from the above-mentioned statements. Both JOSEPH's and PONFICK's materials are derived from autopsies, and therefore are picked, only comprising the lethal cases with no clinical parallel, and on the other hand RAFIN's, THOMAS' and TANNER's, and other authors' statements of age only express the time of the diagnosis, neither taking into account the duration of the symptoms before the diagnosis nor the possibility of a symptomfree lithiasis of long standing. KRETSCHMER, however, does give due regard to this question, and it appears from his report that in several cases calculi have been present for years before the diagnosis, in one case for 8 years and in 8 cases from 1—3 years. CHARVIN and MONSSEAU, reporting 38 cases found that on an average symptoms had been present for 9.7

years before the diagnosis was established. The frequently large size of the stones when diagnosed also seems to indicate that they have existed for years and that their formation dates years back in time.

Etiology.

The age of the child at the onset of the lithiasis now leads to the question as to the etiology of the stone formation, and in this connexion attention has mostly been directed to infancy during which uric acid infarcts are found in the kidneys.

In Denmark SALOMONSEN (1859) and in Germany VIRCHOW among others have demonstrated that the newborn kidney very frequently precipitates already grossly visible uric acid crystals which radiate from the papillae through the pyramids, by VIRCHOW called uric acid infarcts. Presumably this is due to a sudden, very considerable production of uric acid through the kidneys during the first days of life which as a rule rapidly decreases in the course of a few weeks, but may be encountered up to the age of six months. Several authors (inter alii PONFICK, ROVSING, KÜSTER) think that these deposits may be retained in the renal ducts and become nuclei for the formation of actual concretions.

Objections have been raised against this opinion from several quarters. On post-mortem study of 40 children up to 2 years of age JOSEPH only found uric acid infarcts in 3, and therefore did not consider them to be of any importance to the stone formation. KÖNIG reports a patient who at the age of 11 months spontaneously voided a calculus consisting of calcium carbonate, and later, at the age of 17, had 14 phosphate-carbonate stones removed from one kidney, without either time traces of uric acid being demonstrable in the stones, so he too points out that the uric acid infarct need not always be the explanation of stone formation in childhood.

The remaining factors that have been discussed as causes of stone formation in childhood like avitaminosis, infection, urinary stasis, hypercalcemia, and physico-chemical changes in the urine do not seem to have been further elucidated in the reports on urinary calculi in children, for which reason the question will not be further dealt with here.

Anomalies of the Urinary Tract in Connexion with Calculi.

On account of the not infrequent combination of stone and anomaly, congenital anomalies as a predisposition to calculus formation in the urinary tract have been discussed, but almost exclusively by American authors. The matter is, however, not only of theoretical, pathogenic, but also of practical interest owing to the fact that the combination stone-anomaly sometimes can influence the prognosis as well as the extent of the intervention necessary in the individual case.

Let me, however, at once emphasize that some vagueness seems to prevail regarding the terminology of the subject. Some authors exclusively apply the term anomaly to the changes in the urinary tract considered to be actually congenital, whereas others use the word indiscriminately meaning actual congenital changes as well as various morphological changes which just as well might have arisen at a later date in consequence of external influence. The term megalo-ureter thus by some is used indiscriminately barely designating a large ureter taking no regard to the cause, be it stone, stricture, ureterocele, or similar lesions, or a primary, congenital anomaly. Others, no doubt correctly, reserve the term megalo-ureter for the primary cases, which is of importance, not only from an etiological, but first and foremost from a therapeutic point of view. One ought not to be content with the purely symptomatic diagnosis of megalo-ureter, without trying to distinguish between the large, secondary dilatations, the cause of which frequently may be eliminated by operation, from the primary dilatations, the treatment of which is more problematic. This distinction in the terminology has, as far as possible, been adhered to in the present paper.

Anomalies of the urinary tract are no rarity. On the contrary various post-mortem materials contain from 2 to 13 per cent deviations from normal conditions. Not all of these anomalies are of actual importance to the pathology, but several not infrequent changes like stricture in various parts of the efferent ducts, formation of valves, primary dilatations, double ureters and kidneys, congenital obstructions of the bladder neck, unilateral aplasia, etc. seem, according to recent investigations (CAMPBELL, HUNNER, HYMANN et alii), to play no small part in the urinary pathology, especially in childhood.

The most noteworthy changes in this connexion are in part the strictures and in part the congenital, primary dilatations in relation to urinary calculi. Some authors consider strictures and possible dilatations as a secondary consequence of the lithiasis, but others hold that strictures and possible dilatations should be interpreted as primary, maybe congenital anomalies with the calculi as a secondary complication.

Primary congenital strictures in the various parts of the ureters have been encountered on autopsy by MOTZFELDT, ROSCHER, BUGBEE and WOLLSTEIN, BIGLER, SCHREIBER, and others, and clinically demonstrated by KRETSCHMER, HUNNER, CAMPBELL, HYMANN, MERTZ and others. Congenital dilatations are known from autopsy (BUGBEE and WOLLSTEIN et al.) as well as clinical experience, being described by LEGUEU and PAPIN, GAYET and ROUSSET, CAULK, LEYH and others under various names like megalo-ureter, hydro-ureter — congenital hydronephrosis — beance de l'orifice.

Whether these morphological changes are primary, congenital or not will not be dwelt on here, although there hardly can be any doubt that part of them at any rate must be considered as being of congenital origin. In Scandinavia, SUNDAL in 1935 among others discussed the question. In this connexion a confirmation or a repudiation is required of the matter as to whether stones in relation to these anomalies are a common finding, and in this respect the literature seems to abound with possibilities: There are cases of anomalies alone as well as stones alone, and finally the combination of stones and anomalies.

As regards the isolated anomalies, CAMPBELL by a post-mortem study of children found 95 cases of ureteral stricture without any stones at all, and by a clinical study of 258 ureteral strictures only 4 cases of stones. In a material from v. LICHTENBERG's department of 128 cases of anomalies in children SCHMUTTE found 20 per cent ureteral strictures without stone formation. MERTZ found no stones in 20 cases of congenital anomalies in children comprising ureteral strictures, primary dilatation, and ureterocele. KRETSCHMER had 4 cases of strictures in the lower ureteral region without stones, and HYMANN 10 cases of hydronephrosis caused by strictures, and finally ABRAHAMSEN has reported 4 cases of children with ureteral stricture without stones. The above is only a small extract of the gradually rapidly increasing literature on the clinical importance of the ureteral strictures.

Reports on the primary hydro-megalo-ureter do not either contain references to observations indicating an attendant stone formation in the upper urinary tract. Escat in this respect differs from other authors in reporting 9 cases of a so-called megalo-ureter accompanied by stone formation, but his diagnosis has been justly criticized by PAYET and ROUSSET and ELANSKY who point out that these children have neither been subjected to cystoscopy nor cystography so that they cannot be distinguished from cases of primary lithiasis with secondary ureteral atony.

While a large number of authors have not found stone formation attending demonstrable anomalies, stones are just as often encountered in the urinary tract without anomalies being demonstrable. Anomalies are not mentioned in any of THOMAS' and TANNER's 203 cases. Among KRETSCHMER's 21 cases 16 revealed no signs of anomalies and the latter were not either demonstrable in a long series of case reports (ANDRÉ, BROWN, BUTTERFIELD, DIETRICH, EBERT, HAMM, HILL and STEVENS, KÖNIG, SVEN JOHANSSON and many others).

Quite especial interest attaches to the third possibility, a combination of stones and anomalies, which has been described several times. In an 18 month old infant HINNEMANN found a stone in the left kidney and a stricture in the uretero-pelvic juncture, and in another 18 month old infant BURSTEIN found a ureteral stone lodged astride a Y-formed ureter. SZENTHE reports a case of a boy of 11 with a pelvic stone and a stricture in the uretero-pelvic juncture. By constantly controlling 101 cases of ureteral stricture HUNNER could demonstrate 9 cases of secondary stone formation, and elsewhere he reports 2 cases of children, one aged $2\frac{3}{4}$ years with a bilateral stricture in the lower part of the ureter and stone formation in both kidneys, and the other, aged 7, with a bilateral ureteral stricture, bilateral hydronephrosis, and stone in right kidney. KRETSCHMER found aberrant vessels in one case of renal stone, vesical stone complicated by a sphincteral sclerosis in 2 cases, and 1 case of simultaneous valve-like formations in the urethra. CAMPBELL reviewing 30 cases of lithiasis in childhood, points out that cases of demonstrable stones as a rule also reveal strictures somewhere in the urinary tract below the stones. In this country ABRAHAMSEN has published a case of ureteral stone + stricture, but in this case it is hardly possible to decide which is primary, stone or stricture.

The above does not lead to any certain conclusion as to anoma-

lies in relation to stones in the urinary tract, but it seems evident that stones in these regions are no rare occurrence without any anomalies at all being demonstrable, just as the reverse, easily demonstrable anomalies without attendant stone formation, occurs quite often. This, however, leaves a certain percentage revealing stones with simultaneous morphological changes of the urinary tract, like stricture or dilatation. Some of these strictures or dilatations may easily be explained as sequels of stones (secondary hydronephrosis) whereas others as e. g. stricture in the first year of life probably must be considered as a primary, congenital anomaly preceding the attendant stone. In these cases stasis possibly contributes to promote the stone formation, although e. g. BOE-MINGHAUS completely repudiates the influence of urinary stasis on stone formation. His view is that the reduced renal function and the lacking capacity of concentration is of such influence on the composition of the urine as to exclude stone formation. According to him this accounts for the extreme rarity of encountering stone formation in case of hydronephrosis.

But despite the continued vagueness concerning the etiological relation between anomalies and stones in the urinary tract, their not infrequent simultaneous occurrence entails a duty to keep the congenital anomaly in mind whenever encountering stones in children. Diagnosis as well as treatment should not only be based on the lithiasis proper, but the physician should also try to discover the concurrent existence of anomalies which, if present, must be taken into account when contemplating the extent of the intervention.

Symptoms and Diagnosis.

The symptomatology during childhood does not seem to differ essentially from that in later life. It appears in the same manner with pain, hematuria, urinary frequency, painful urination, now and then enuresis, passage of stones, possibly signs of infection, and sometimes gastro-intestinal attacks. But just like adults, children have been known to present cases which have developed without giving clinical symptoms of any kind for years.

The most frequent symptom is considered to be pain, dependent on the site of the stone as to character and localization. Renal stones, found to cause pain in 93 per cent of the cases by THOMAS & TANNER, and in 100 per cent by KRETSCHMER, give more or

less urgent, persisting, not especially colicky pain, which either may be localized to the loin or more diffusely to the abdomen. Ureteral stones hardly as often cause pain (70—80 per cent), perhaps because in childhood the ureters seem more dilatable and therefore furnish easier passage, making obstruction a more rare phenomenon than in adult life. But if the pain does occur it may become violent and the diagnosis is complicated by the more or less vague localization of the pain to the abdomen. In infancy it may often be confused with intestinal symptoms and a diagnosis of intestinal disorder has therefore been established in a number of cases. Of importance to the differential diagnosis is that ureteral colic causes persistent pain that remains unchanged for hours, in contradistinction to the abdominal colic which is described as being of a more intermittent, colicky character. Frequently it is impossible to pass a differential diagnosis, but any syndrome of recurring attacks of abdominal pain without intestinal symptoms should indicate urinary stone and result in an examination of the urinary tract.

Hematuria is a common symptom. In THOMAS' and TANNER's material it was present in 50 per cent of the cases and KRETSCHMER came to a similar result, whereas several FRENCH authors consider hematuria in childhood to be a comparative rarity.

As mentioned above frequent and painful urination is a common symptom of bladder stones which also may cause enuresis.

Few reports exist of the spontaneous voiding of stones in childhood, but it does happen as also suggested by the frequent finding of stones in the urethra. KRETSCHMER found spontaneous passage in 3 out of 21 cases.

Signs of infection or gastro-intestinal attacks belong to the misleading symptoms. Repeated attacks of fever may occur without focal symptoms from the urinary tract drawing the attention to this region, and the same thing is true of the gastro-intestinal symptoms.

The difficulty in passing the diagnosis has already been dealt with. Repeated, careful urinalysis, however, sooner or later probably will afford the clue to the diagnosis. KRETSCHMER in all his patients, sooner or later, found changes in the urine in the form of microscopical pyuria or hematuria and sometimes signs of infection.

A more detailed urologic examination supplemented by X-ray will lead to the correct diagnosis, most stones giving a shadow on

the film. Cystoscopy can also be performed without difficulty in childhood, if the necessary instruments are available. THOMAS and TANNER have cystoscoped 8 months old baby girls and boys of 5—6, and American authors frequently have pointed out that cystoscopy is on the whole well tolerated by children. Finally cystography in childhood is an important method of examination, disclosing among other things whether the contractility of the ureteral orifices is sufficient or not and thereby shedding light on things of pathogenetic as well as prognostic character.

Prognosis.

Opinions differ widely as regards the prognosis, but exact enlightenment is lacking, most of the materials being too small and the follow-ups of the individual patients being too brief, both before and after the diagnosis and operation.

THOMAS' and TANNER's report seems to be the only one in literature which has endeavoured to carry through after-examinations, but it is a compilation from urologists from all parts of America which makes judgment difficult. Among 155 of their cases which were operated upon 46 per cent had not been followed up. Out of the 54 per cent which had recovered after the operation 2.5 per cent revealed symptoms of recurrence, but no mention is made as to whether the stones had recurred or not. (The time of the after-examination is not stated). Lastly 2 died. The after-examinations, however, suffer from the fault that no roentgenograms seem to have been taken. It will be seen later that an X-ray examination is an indispensable necessity in deciding the existence of a stone recurrence. The larger, pure autopsy materials and the rather numerous cases in several of the clinical materials in which the diagnosis has not been established until autopsy, probably give a too biased picture of the course of the disease, but at any rate they indicate the serious prognosis during the first years of life. The long time which in some materials seems to have preceded the diagnosis (CHARVIN and MONSSEAU thus found 38 cases with an average of 9.7 years) on the other hand implies a good prognosis. The predominant amount of vesical and urethral stones in proportion to the aggregate cases also seems to indicate that the stones are liable to pass down without having caused lesions to other regions of the urinary tract. PAISSEAU and LAMBLING even consider the prognosis to be amazingly good. They declare to

have ascertained that lesions to the urinary tract caused by stones are only slight, that infection does not exceed the catarrhal stage, and that complications of infections hardly occur. THOMAS and TANNER also consider the prognosis to be good. DRACHTER too believes that the prognosis is good apart from the bilateral cases and considers the percentage of recurrence to be considerably lower than in the case of adults, without, however, being able to give a numerical elucidation of the question.

The prognosis is, however, considerably worse in case of bilaterism, the frequency of which is very differently stated by the various authors. RAFIN found 15.3 per cent, THOMAS and TANNER 33 per cent, and JOSEPH not less than 65 per cent.

Treatment.

Finally as regards the treatment of children as well as adults it is difficult to work along exact lines. One must take a number of factors into consideration: the size of the stones, their growth, the subjective symptoms, and the embarrassment they cause, the already existing complications as well as those about to arise, like infection and stasis. In accordance with the above the views concerning the treatment of lithiasis in childhood are extremely varied.

OMBREDANNE e. g. is very reserved concerning the treatment of renal and ureteral stones and only regards very pronounced symptoms, such as great pains, frequent hematuria, and infection as operative indications. His views are shared by PAISSEAU and LAMBLING. On the other hand COLLINS takes a considerably more active view and emphasizes the advantage of early diagnosis and treatment. COLLINS, however, considers the operative risk greater in the case of children of tender years than adults, but on the other hand he points out that by not removing the stone one risks serious destruction of the kidney substance and a high mortality, a view shared by most American authors. DRACHTER also recommends prompt surgical intervention.

Judging from the literature ureteral stones in childhood seldom require treatment, and if they do the treatment should be along conservative lines (DRACHTER) just as it is in adult life. Still, THOMAS' and TANNER's material of 26 ureteral stones contains 6 cases of ureterolithotomy, and it is generally accepted that ureterolithotomy should be considered in cases of obstruction

with stasis in the upper urinary tract. Bladder stones are removed by the suprapubic approach; only in case of older girls lithotripsy is recommended as a method of treatment.

At last I shall briefly mention the significance of urinary anomalies in the treatment of urinary lithiasis in children. But let it be said at once that within this scope so little is known and experience is so slight that it only enables me to hint at the possibilities of treatment at disposal on the basis of the literature.

Stricture at the uretero-pelvic juncture may be an indication for nephrectomy, if the kidney is in a very bad condition and the other side is normal, whereas bilateral stricture calls for conservative plastic treatment, possibly preceded by nephrostomy in case of severe infection.

Stricture in the lower part of the ureter may, besides nephrectomy, call for plastic treatment or repeated dilatations with a ureteral catheter through the bladder as recommended e. g. by HUNNER.

As regards the opposite of strictures: the primary hydronephrosis — hydro-ureter — it is so exceptional in combination with stone that the problem as to treatment hardly exists. But presumably the treatment must in the main be adapted to the primary anomaly, and as long as there is no infection it should be essentially conservative, whereas a more serious infection at any rate often calls for nephrectomy.

As an example of the treatment of anomalies in connexion with stones it may be stated that HINNEMANN performed nephrectomy on a girl of 18 months instead of simple lithotomy, because of a stricture in the uretero-pelvic juncture, whereas HUNNER in 2 cases of stricture in the lower part of the ureter was content with lithotomy with subsequent repeated dilatations of the stricture by way of the urethra with intervals of a few days. In a case of a right-sided pyonephrosis caused by a stricture in the uretero-pelvic juncture and a stone of the left kidney, SZENTHE performed primary nephrostomy on the right side followed by lithotomy on the left side, and at last on account of a persistent right-sided fistula, ureteroneopyelostomy which 5 years later proved to be effective.

The cases serve to emphasize the importance of recognizing anomalies that may be present besides stones, as this complication must be taken into account when deciding the extent of the surgical interference.

In a subsequent paper I shall review a clinical material of urinary lithiasis in 71 children treated at the various Copenhagen hospitals since 1929. It will be seen from this material that in Denmark at any rate urinary lithiasis in childhood hardly can be called an uncommon disease.

Summary.

On the basis of especially the more recent literature the author gives a survey of the incidence of urinary lithiasis during childhood in Europe and America.

Zusammenfassung.

Sich vorzüglich auf die neuere Literatur stützend, gibt Verf. eine Übersicht über das Vorkommen von Lithiasis im Harn bei Kindern in Europa und Amerika.

Résumé.

Se basant spécialement sur la littérature récente, l'auteur relate sur la fréquence de lithiasis urinaire pendant l'enfance en Europe et Amérique.

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From the Roentgen Clinic of the State Hospital, Copenhagen.
(Chief: Prof. P. FLEMMING MØLLER, M. D.)

Bloodless Reduction, under Roentgenologic Control, of Acute Volvulus of the Sigmoid Flexure.

By

FLEMMING NØRGAARD, M. D.

As it is the case with many other forms of ileus, volvulus of the sigmoid flexure can before operation practically only be diagnosed with certainty by roentgen examination of the abdomen. As this examination in most cases, besides plain roentgenography, will require observation under rectal administration of a contrast substance it lies near in such cases to attempt to reduce the volvulus at the same time. Just as the simple administration of an enema will sometimes suffice to untwist a volvulus, thus it now and then happens that the mere injection of a contrast fluid for diagnostic purposes accomplishes the same result; and the process may then take place so quickly that only the closest attention on the part of the observer during the inflow will ensure information about the nature and development of the pathologic condition. But in other cases, — and these are undoubtedly the majority of those that come to roentgen examination, — the bowel only fills as far as to the junction of the rectum and the sigmoid, or for a greater or lesser distance up into the latter, where the lumen of the gut is occluded. Depending on the form of the volvulus, this occlusion will be due either alone to the two sections of the bowel being twisted tightly about each other or — oftener — also to a sharp local, axial torsion at the same point or more orally. Any twisting of a loop of the bowel about the mesentery is accompanied by a twisting of the bowel itself about its own longitudinal axis. If this axial torsion is distributed over a considerable length of the bowel it does not give rise to any symptoms and will often not

be noticed at all; but if confined to a shorter length it causes narrowing, or even complete oclusion, of the bowel, and may then moreover give rise to nutritional disturbances in the wall of the latter (K. E. GROTH, 1934. See also among others H. LAURELL and FL. NØRGAARD.) Such shortening of the axial torsion occurs, for instance, when the twisted loop becomes distended, and the oral part of the contrast shadow at the site of the oclusion will then take the shape of a bird's beak (LAURELL) or a more or less spiral form. In such cases reduction of the volvulus may sometimes be accomplished simply by letting the recumbent patient keep on turning about his longitudinal axis during the administration of the contrast enema. That the result can be obtained in this manner is, as LAURELL points out, because the usually heterogeneous contents of the gut (gas, fluid and more solid components) as a rule are unequally distributed in the two legs of the twisted loop, so that these will be of different weight and therefore will have a tendency to change their position both in relation to each other and to the other abdominal organs. When the patient shifts his position there is therefore a chance that the two legs of the loop may slide past each other in the opposite direction to that which has caused the volvulus. From the direction of the beak-shaped or spiral-twisted oral part of the contrast shadow and its changes during the patient's movements one may then try to find the direction of these that will be most likely to bring about the reduction, as an incipient slacking of the torsion of course shows itself by a further advance of the contrast fluid.

The first condition for accomplishment of the untwisting is that there is room in the abdomen for the twisted coils to perform these movements. If the distention of the bowel caused by the volvulus is very great, and especially if the abdominal wall is very tightly stretched, their displacement cannot take place without some special intervention. In not a few cases of this kind the necessary relaxation of the abdomen may be brought about by carrying a sound up through the twisted portion of the bowel under fluoroscopic control and partly emptying the latter before the actual attempt at reduction is made. On the basis of two cases in which this method was used I shall describe the technic of this operation. LAURELL mentions the possibility of applying it, and since I used it in the first of our cases a similar one has been reported by B. S. HOLMGREN; but otherwise I believe that the method is not generally known.

Case 1. — The patient, a man 25 years old, was admitted to the State Hospital, surgical service D, on May 7th, 1941, for an acute abdominal disorder. He had had similar attacks respectively three years and a year and a half before, and had on both occasions been treated at home, with rest in bed for three—four days. Between the attacks he had been entirely well. Now he had suddenly, two days ago, got a pain in the lower right side of the abdomen, extending to the entire lower part of the latter and around into the loins. It came on in spells, with free intervals of as much as several hours between. His bowels had not acted since the attacks began, but a little water had been quitted at attempts at defecation. He thought that some flatus had passed. No vomiting. No dysuria.

Objective examination showed temperature $38^{\circ}.2$, pulse 72. The abdomen was soft, not particularly distended. There was moderate tenderness over McBurney's point, otherwise nothing demonstrably abnormal. During the following night he was observed in the ward. The pain still came on in spells; the temperature was falling, to $37^{\circ}.7$. No vomiting; a small quantity of mucus discharged *per rectum*. The abdomen still soft; no bowel sounds, not even during the attacks.

On the following day, May 8th, the patient was sent for *roentgen examination of the abdomen*. Roentgenography, without contrast substance, both in recumbent and upright position (*Fig. 1*) showed marked ileus in the colon, the abdomen being filled with large, greatly distended coils of the latter containing chiefly great quantities of gas, but also to a lesser extent, fluid, which with the patient in upright position showed as typical fluid levels. One long coil in particular, which from the small pelvis extended all the way up under the left dome of the diaphragm and from there again turned downwards towards the small pelvis, was enormously distended, in circumference bigger than an upper arm. In its lower part, where its two legs met in the small pelvis, there were a couple of distinct fluid levels. Though also the other parts of the colon were considerably distended by gas, — besides which the ascending part, especially, contained rather large masses of fecal matter, — and though a couple of the lower loops of the ileum were similarly gas-distended and showed fluid levels, the roentgenographs made it reasonable to suppose that it was a case of volvulus of the sigmoid flexure. There was undoubtedly a small quantity of free fluid in the peritoneum.

To make the diagnosis certain, an opaque enema was given, and with the consent of the referring service it was decided at the same time to make an attempt at bloodless reduction of the volvulus under fluoroscopic control. The rectum filled readily, but at its junction with the sigmoid a complete obstruction to further passage was encountered, of the hook- or beak-shaped form typical for volvulus. Further attempts at injection with the patient lying on his back caused him great pain; but by making him turn in various ways, both on his side and on his stomach, I succeeded in getting a little of the contrast fluid to pass the stenosis (*Fig. 2*), with the result that a design resembling a feather-duster appeared there and a little of the enema advanced farther up

into the lumen of the gut. It was now clear that there must be a volvulus of at least 360 degrees, with a local axial torsion, also of 360 degrees, right at the point where the two sections of the bowel twisted about each other.

Under continued careful injection the bowel above the stenosis became still a little more dilated, and suddenly the volvulus partly untwisted itself, so that the turn was now only of 180 degrees. But at the junction of the rectum and the sigmoid corresponding to this there was still a markedly localised axial torsion of 360 degrees (*Fig. 3*; side view), which in spite of attempts with alternating evacuation and renewed injections of the enema could not be straightened out. A half-stiff stomach sound well smeared with vaseline was therefore under fluoroscopic control introduced into the rectum, and was by light, turning movements rather easily made to pass up through the twisted portion of the gut; whereupon not only the injected enema, but also large quantities of gas and feculent fluid escaped through it, with the result that the twisted bowel collapsed and the abdomen became quite soft. By renewed injection of enema — through the sound — it was now possible to straighten the bowel out completely; but it still had a tendency to twist back 180 degrees. As the ileus had been done away with and the great distention of the long loop of the sigmoid, which was the chief hindrance to spontaneous reposition of the bowel, had been reduced, further manipulations were, however, desisted from; but the sound was left lying in the rectum, with its tip high up in the sigmoid. During the following twenty-four hours the patient was entirely well, whereupon it was removed.

A week later the colon was again roentgen-examined under injection of contrast enema, and the bowel now filled readily all the way up to the cecum. The sigmoid was very long. In dilated condition it extended up under the left cupola of the diaphragm, running from there down into the left iliac fossa, where it continued in the descending colon. Also the transverse colon was long and very looped. The bowel lay in its normal place.

As the defecation could be kept in order with laxatives and there was risk of the patient losing his situation if his stay in the hospital was protracted, radical operation was not attempted; and on May 18th he was discharged, but was told to come back if the attacks recurred.

A year later (May 10th, 1942) he was, however, admitted to another hospital in Copenhagen (Bispebjerg Hospital, service D) for precisely the same disorder, of about 18 hours' duration. Roentgen examination showed typical volvulus of the sigmoid flexure, and laparotomy was immediately performed, with resection of the megasigmoid and cecostomy. The bowel was first untwisted 2×360 degrees in the direction of the clock. After forty-nine days he was discharged, and since then he has had no abdominal attacks.

Épïcrisis. — A man, 25 years old, is admitted to hospital after having for two days suffered from acute attacks of abdominal pain of rather uncertain character. He has had similar attacks twice

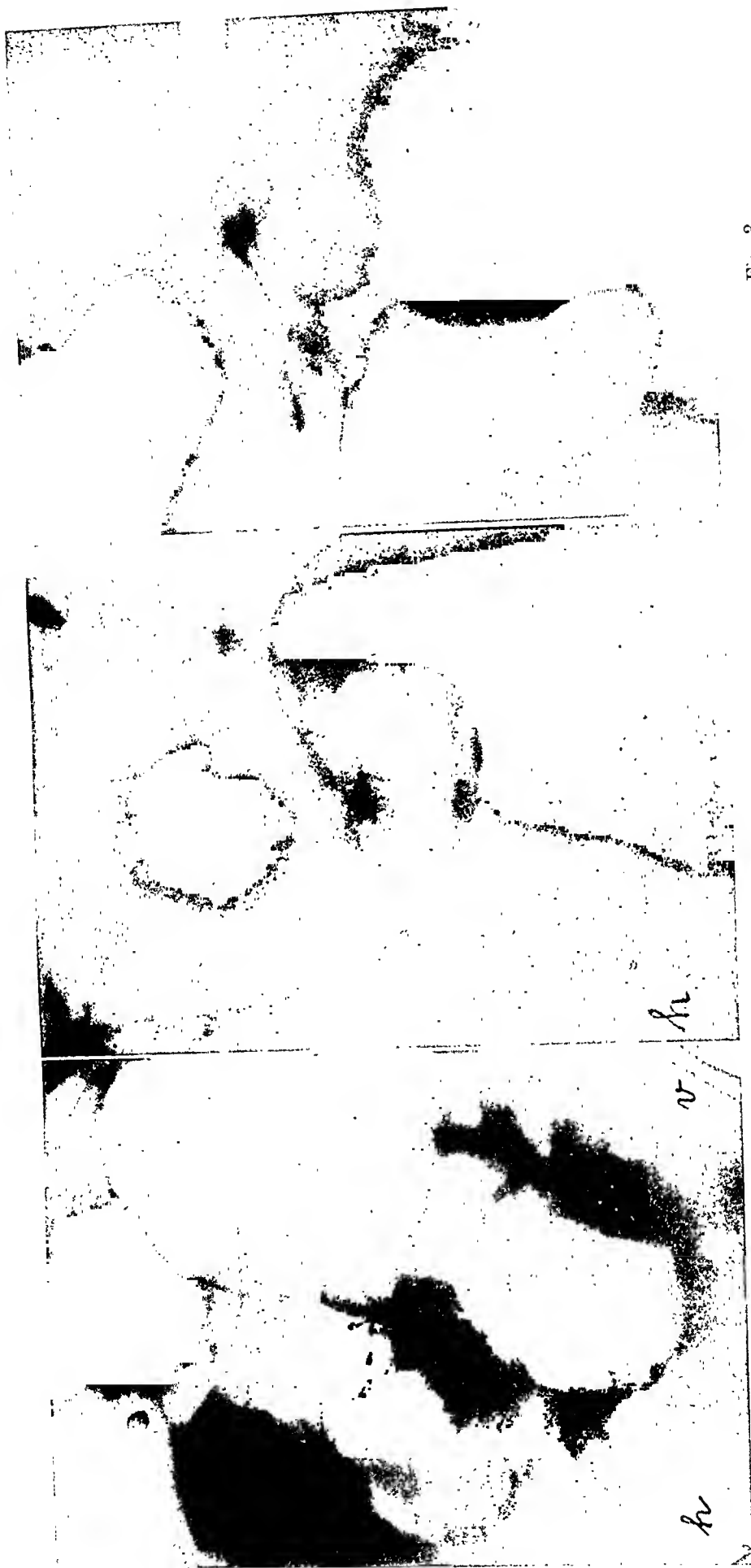


Fig. 3.

Fig. 2.

Fig. 1.

NØRGAARD: Reduction of acute volvulus of the sigmoid flexure.

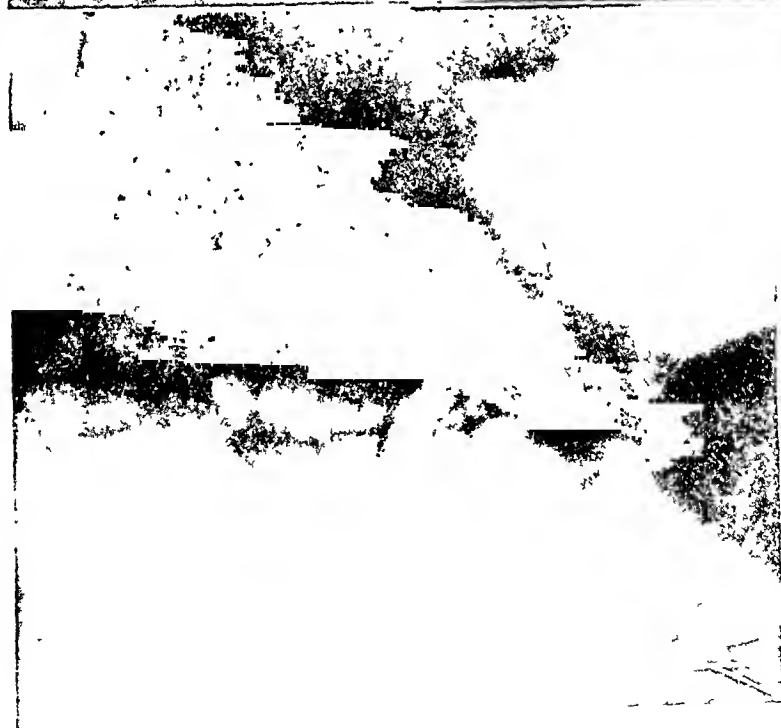


Fig. 4

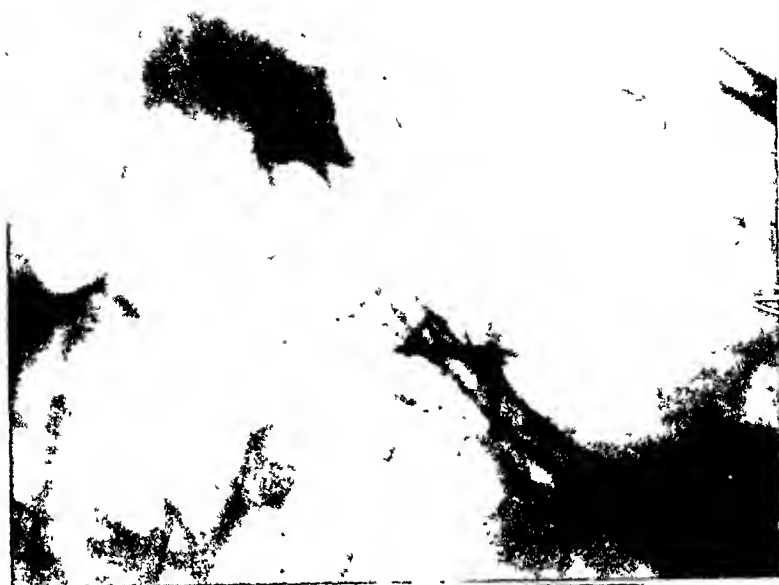


Fig. 5

before, which disappeared again spontaneously. Roentgen examination of his abdomen the day after admission shows typical volvulus of the sigmoid flexure, of 360 degrees. On injection of a contrast enema this volvulus becomes half-way untwisted, but complete detorsion — whereby also a tight local axial torsion of 360 degrees is straightened out — is only obtained after a half-rigid sound has been introduced in the rectum and carried up past the stenosing part, and the contents of the gut evacuated through it. A year later he has a recurrence, and an operation is immediately done in another hospital, with untwisting and resection of the large sigmoid.

Case II. — A man, 63 years old, was admitted to the State Hospital, surgical service D, on April 5th, 1943, for *sibileus*. Since 1917 he had many times been a patient in other hospitals, being treated for melena, coprostasis in the megacolon and abdominal attacks of a character suggesting a condition of ileus and volvulus. The latter had in most cases been overcome by introduction of a rectal sound; but a year previously he had been operated on and a volvulus of 360 degrees been straightened out by simple untwisting. Since then there had been no fresh trouble until he now, two weeks before admission, began to get paroxysmal attacks of pain in the left side of the abdomen. In the last twenty-four hours these attacks had become more severe, and neither flatus nor feces had passed. There were no symptoms from other organs.

Objective examination showed temperature 37° , pulse 56. The abdomen was distended; most so in the left side, where there was tenderness, bulging of the bowel and gurgling sounds.

The patient was sent for *roentgen examination of the abdomen*. Roentgenography in recumbent position, without contrast substance, showed large colonic coils grossly distended by gas. One of them especially, situated medially, with its highest point in the left side of the epigastrium, was enormously distended, and its wall quite smooth. The others, which corresponded to the descending, transverse and ascending parts of the colon, showed distinct haustration and were only half as distended. Whether there was any gas in the small bowel could not be said with certainty. In pictures taken with the patient in upright position a large fluid level was seen in each side of the large, medially situated coil of the colon, but most of its content by far was gas. It was no doubt a large loop of the sigmoid, where there was probably a volvulus.

A contrast enema was therefore given, especially with a view to bloodless reposition. The rectum filled readily, but at its junction with the sigmoid an absolutely impassable obstruction was encountered, and there the opaque shadow ended in a characteristic manner with the sharp, beak-shaped figure typical for a volvulus, which, to judge from the course of the loop, was probably of 360 degrees. As further injection was impossible, because the twist did not loosen even when the patient turned about on the couch, a rather soft stomach sound was introduced

into the rectum; and by cautiously screwing it forwards under alternating injections (under rather high pressure) and withdrawals of the enema, while the patient shifted his position in various ways, it was made to pass the twisted part (*Fig. 4*). After it had been carried up into the grossly distended sigmoid, the latter was easily emptied of large quantities of gas and feculent fluid. The patient's pain immediately ceased, but the bowel did not become untwisted; the volvulus was still of 360 degrees, and at the junction of the rectum and the sigmoid there was around the introduced sound distinctly seen (*Fig. 5*) a markedly localised axial torsion of fully 360 degrees. It was still impossible to get the enema into the descending colon, past the point where the oral end of the twisted loop crossed the rectum; perhaps only on account of the tightness of the twist, perhaps on this account in connexion with the presence of a localised axial torsion also at this point. But by repeated injections and withdrawals of the enema through the introduced sound, whereby the two legs of the twisted loop were filled in varying degree, and by having the patient during these operations turn now to one side, now to the other, I finally succeeded in getting the volvulus untwisted. The bowel then returned to its natural position, and could without difficulty be filled in its entire extent and again emptied spontaneously.

Immediately afterwards the patient was quite without pain, and the abdomen soft. Flatus passed, and there was a copious discharge of the barium enema; later also of feces. During the first days there was positive benzidine reaction in the latter; later not. The action of the bowel was kept in order with laxatives. Radical operation was declined by the patient.

Two and a half months later he was admitted to another hospital (Bispebjerg Hospital, service D) for an entirely similar attack of two days' duration. Roentgen examination of the abdomen showed volvulus of the sigmoid flexure, with ileus involving also the small bowel. At admission his general condition was otherwise good. Laparotomy was immediately performed, with anteposition of the megasigmoid and cecostomy. The gut was untwisted 180 degrees. There was no nutritional disturbance of the bowel at the site of the twist. In the peritoneum there was considerable serosanguineous fluid. There was some difficulty in getting the bowel drawn forward, partly owing to the presence of adhesions between the upper part of the loop of the sigmoid and the inner side of the cicatrix after the earlier laparotomy, partly because some coils of the small bowel were incarcerated laterally to the large sigmoid. These could, however, be put back in their former place. The sigmoid was drawn forward, and was two days later resected by electroscission in the usual manner, whereupon the bowel functioned by lavage. On the fifth day there was copious seepage through the bandage, and the patient was in a marked state of shock of peripheral origin (not from bleeding). From this he rallied temporarily after blood transfusion, 1000 ccm, and infusion of physiological saline solution and solution of bicarbonate, 500 ccm of each. The following day he was again in a state of shock, with slightly rising temperature. An infusion of serum, 750 g, had only a passing effect, and he died. *Diagnosis at necropsy:*

Stenosis and incipient gangrene of the ileum. Condition following excision of the sigmoid flexure and cecostomy. Acute stasis of the organs. Arteriosclerosis of the aorta and the coronary arteries. Fibroma of the duodenum.

Epicrisis. — A man, 63 years old, with an abnormally long sigmoid, has in the past twenty-five years repeatedly been admitted to hospitals for paroxysmal attacks of abdominal disorder resembling volvulus. A year ago he was operated on and a volvulus of the sigmoid flexure untwisted. After incipient symptoms for two weeks there has now again been complete ileus for twenty-four hours. Roentgen examination shows volvulus of the sigmoid flexure, of 360 degrees, impassable for contrast enema. A soft sound is under fluoroscopic control introduced *per rectum* and carried through the twisted portion of the gut, and after the contents of the long, distended sigmoid have been evacuated through it the volvulus is after several attempts untwisted. The patient is now for a time well; but two and a half months later he is again in hospital, with a volvulus of two days' duration, but otherwise in good general condition. An operation is immediately performed, with exposure of the sigmoid and cecostomy. The postoperative course is at first normal, but on the fifth day he falls into a state of shock of the peripheral type, from which he only temporarily rallies, and on the sixth day after the operation he dies.

The two cases show that it is possible under fluoroscopic control bloodlessly to reduce some cases of volvulus of the sigmoid flexure which it would absolutely have been impossible to reduce by ordinary enema or by attempts to introduce a rectal sound. The method I have here described must also entail less risk than the introduction of such a sound either blindly or through a rectoscope, or than more or less forcible bowel lavages.

The attempt to carry the sound through the twisted portion of the gut must of course always be made rather cautiously. The sound must not be too stiff, and it must be pushed forwards in such a direction that it follows the lumen of the gut and is not suddenly pressed against the wall of the latter at some point or other, especially after its tip has entered the twisted loop. But when it has advanced so far there is on the other hand no need of employing very much force.

To make the passage of the twisted portion easier, HOLMGREN uses a sound with a slightly curved tip, and LAURELL has suggested

the possibility of having a special sound made, with a thread through it and fastened to the tip, so that the latter could be directed in one way or another by pulling more or less on this thread. In our two cases we used an ordinary stomach sound with the opening on the side, a short distance from the tip; and by rotating it between the fingers as the tip neared the site of the twist, in the same direction as the lumen there began to curve, we got it to enter into the spiral-twisted part of the latter. By having the patient turn so that the torsion slackened a little, — which could be controlled by means of the contrast fluid injected through the sound at the same time, — we succeeded after a few attempts in passing all the way through the obstruction. How quickly this operation can be done will no doubt to some extent depend on practice; but on the whole it is not more difficult than that it can be carried out by anyone who is capable of forming an estimate of the conditions as they present themselves under the fluoroscope.

After the sound has been carried through and the contents of the bowel emptied through it, it will in most cases be necessary to get some contrast fluid injected into the loop in order to make its two legs heavy enough to make them slide past each other during the attempts to get the volvulus untwisted by having the patient turn from one side to the other. But this injection must, of course, not be carried so far that there will be any risk of rupture of the more or less damaged wall of the closed loop. In that respect one must be guided by the patient's sensations of pain and the degree of distension to which the gut has been subjected.

As regards the indications for and against attempts at this bloodless reduction instead of immediate surgical intervention it must be clearly understood that the possibility of even incipient gangrene in the loop of the bowel must be considered as an absolute contraindication. Whether such a condition is present cannot be seen from the roentgenographs. The quite smooth and grossly distended bowel must be considered as paralytic, but the condition of its wall in other respects cannot be judged from this. The presence of any considerable quantity of free fluid in the abdomen, as well as, of course, the picture of a paralytic ileus, makes it probable that the wall is rather severely damaged. For the rest, the clinical picture must be determining. In cases of long-lasting complete occlusion with increased (and increasing) temperature and great tenderness of the involved loop, combined with constant

severe pain in the abdomen, it will undoubtedly be unwise to try the method. In all other cases I believe that it must be permissible to make the attempt at bloodless reposition under fluoroscopic control. In the case of elderly patients, and also in other cases where surgical intervention is more or less strongly contraindicated, it may even be advisable first to try that method, instead of at once proceeding to operation.

As also the reported cases show, the successful bloodless reposition should, however, undoubtedly in all cases where it is possible be followed by radical operation after the acute symptoms have subsided. The advantage of having gotten the volvulus untwisted bloodlessly is then that the surgical intervention will be of lesser magnitude and will entail less risk than an operation while the ileus with its attending intoxication is still present and the patient's general condition in consequence more or less enfeebled.

Summary.

The author reports two cases in which a complete volvulus of the sigmoid flexure (360°) was untwisted bloodlessly under fluoroscopic control. He describes the procedure in detail and discusses the advantages of the method over surgical intervention during the acute attack, its contraindications and possible risks. He considers gangrene, or incipient gangrene, of the twisted loop as the only contraindication, and believes that if the technic he describes is followed it should be permissible to try the method in all other cases. If the untwisting succeeds, it should as a rule be followed by radical operation after the acute symptoms have subsided.

Zusammenfassung.

Im Anschluss an zwei Fälle von vollständigem Volvulus coli sigmoidei (360°), an denen unter Röntgenkontrolle unblutige Reposition (Detorsion, vorgenommen wurde, wird die diesbezügliche Technik eingehend beschrieben. Ausserdem werden die Vorzüge der Methode vor der Operation im akuten Anfall, ihre Kontraindikationen und möglichen Gefahren erörtert. Gangrän und beginnende Gangrän der gedrehten Schlinge gilt als einzige Kontraindikation. Falls die angegebene Technik befolgt wird, dürfte es erlaubt sein, die Methode in allen übrigen Fällen zu ver-

suchen. Gelingt die Detorsion, so muss ihr gewöhnlich die Radikalooperation folgen, nachdem die akuten Veränderungen abgeklungen sind.

Résumé.

L'auteur rapporte deux cas de détorsion non-sanguine, sous contrôle fluoroscopique, de volvulus complet (360°) de l'anse sigmoïde du côlon. Il donne les détails de la méthode et en discute les avantages sur l'intervention chirurgicale pendant l'attaque aiguë, ainsi que les contre-indications et risques possibles. Il estime que la présence de gangrène, ou d'un commencement de cet état, dans l'anse tordue, est la seule contre-indication à son emploi. Sauf dans des cas pareils il pense qu'il sera permmissible d'essayer la méthode, à condition de bien suivre les indications techniques pour son emploi. Si la détorsion réussit, elle devra généralement être suivie d'une opération radicale, dès que les symptômes aigus auront disparu.

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Die transpapilläre duodenale Hepatikusdränage.

Von

Dr. CHR. VAN GELDEREN,

Vorstand der I. chirurgischen Klinik des städtischen Krankenhauses
»Binnen-Gasthuis«, Amsterdam.

Es mag zunächst befremdend erscheinen dass an dieser Stelle ein rein technisch anmutender Gegenstand behandelt wird. Doch bei näherem Zusehen wird sich ergeben, dass die einschlägige Technik nur dazu dient bedeutsamen, manchmal vernachlässigten funktionellen Geschehen gerecht zu werden; sie will dazu beitragen, der diesbezüglichen Chirurgie manches Unphysiologische zu nehmen.

In der Chirurgie des Gallensteinleidens hat sich in den letzten Jahrzehnten die Neigung bemerkbar gemacht, den Hauptgallengang lieber einmal zu oft explorativ zu eröffnen als im unberührten Choledochus Steine zu übersehen. Die etwa 10 % Steinrezidive nach der Cholezystektomie — unter denen sich zweifelsohne zahlreiche zurückgelassene Steine befinden — dürften das ihrige dazu beigetragen haben. Mit der häufiger gewordenen Choledochotomie beansprucht das Verhalten des Chirurgen dem einmal eröffneten Hauptgallengang gegenüber erneutes Interesse. Damals war der überwiegenden Mehrzahl der Chirurgen die Hepatikusdränage (Choledochusdränage) bei eröffnetem Hauptgallengang sozusagen das Verfahren der Wahl. Daran konnte nur noch in dem Sinn geändert werden, dass das Drän statt durch den Bauchschnitt mittels eines gesonderten Stichkanals, abseits der Laparotomiewunde herausgeführt werden konnte. Manchem Chirurgen war das Hepatikusdrän eine technische Notwendigkeit, nicht nur gelegentlich — beim Ikterus — eine Voraussetzung für die Heilung.

Die sonstige Drainage des Gallenblasenbettes (Sicherheitsdrän), bzw. die Gazetamponade desselben, wurde im grossen und ganzen immer mehr eingeschränkt, ja sogar von manchen Fachleuten grundsätzlich unterlassen. Verschleppte pericholezystitische Fälle geben nur noch selten eine Indikation dazu. Man darf mich nicht missverstehen: ohne Choledochotomie und dementsprechend ohne Hepatikus-(Choledochus)-Drän legt zweifelsohne die Mehrzahl der Chirurgen irgendein Drän oder einen Gazestreifen ein: die Galle, welche einem aufgegangenen Zystikusstumpf oder gar abnormen Gallengängen der Leber zum Gallenblasenbett entstammen könnte, soll abgefangen und der Peritonealhöhle fern gehalten werden. Die sogenannte »ideale« Cholezystektomie ohne jegliche Drainage scheint auch mir als Routinemethode von nicht zu verantwortendem Risiko belastet. Ich bediene mich derselben nur ausnahmsweise in vollkommen glatten Fällen, etwa auch in Fällen, wo gleichzeitig eine Magenresektion nach dem Typus Billroth II stattfand, damit nicht das Drän dem Aufgehen des Duodenalstumpfes Vorschub leisten könnte.

Die Hepatikusdrainage (Choledochusdrainage) auch etwa — in lange zu drainierenden Fällen — mittels des T-Dräns, sichert allerdings die Dekompression des Leberparenchyms. Und die gewöhnliche, momentane, schroffe Entlastung ist wohl nicht verantwortlich für die gelegentliche Acholie nach dem Eingriff. Daran scheint mir eher die schon vorliegende, vielleicht durch das Betäubungsverfahren noch gesteigerte Parenchymschädigung der Leber Schuld zu sein. Allerdings ist damit noch keineswegs dargetan, die äussere Hepatikusdrainage sei bei der Gallensteinkrankheit (der Choledocholithiasis) und auf längere Zeit auch bei der chronischen Pankreatitis einwandfrei nützlich und unumgänglich zur Behebung der Gelbsucht, bei der Bekämpfung der Cholangitis. Die äussere Gallendrainage auf dem Wege der Choledochotomiewunde ist nämlich keineswegs gleichgültig. Findet man doch z. B. schon bei KERR die Bemerkung, die äussere Gallenfistel — bei der in Krebsfällen sonst nicht zu behebenden Gelbsucht — schade mehr als sie nütze: die Kranken kommen sehr schnell herunter und erliegen eher. Zwar kann bei freier Papille ein bedeutsamer Teil der Galle in den Zwölffingerdarm geraten und gerät auch dahin. Falls der untere Querschkel eines T-Dräns — was einige als Fehler bezeichnen — absichtlich durch die Papille hindurchgeleitet wurde, ist die Bahn in das Duodenum zweifelsohne von vornherein frei und wird die etwaige Acho-

lie des Darms sicher sofort behoben; das bedeutet (vgl. unten) ganz erheblichen Gewinn. Durch Abklemmung des Längsschenkels des T-Dräns könnte man sogar das Abfliessen der Gesamtgalle in den Darm erzwingen. Doch braucht man dazu ein T-Drän; auch falls der Querschinkel rinnenförmig aufgeschnitten wird, bleibt eine grössere Choledochuswunde nach seiner Entfernung der Vernarbung überlassen als nach einfacher (Nelaton-)Drainage des Hauptgallengangs; mit Rücksicht auf postoperative Narbenstriktur wäre das nicht gleichgültig. Schon aus diesem technischen Grunde könnte man jede Choledochusdrainage wegen der sekundären Heilung der vorläufig aufgesperrten Choledochuswunde beanstanden.

In neuerer Zeit wurden wiederholt Vorschläge gemacht, die äussere Gallendrainage grundsätzlich zu umgehen. Diese Bestrebungen verdienen zweifelsohne besondere Beachtung. Zunächst heilt der Hauptgallengang wohl glatter und narbenstrikturfreier nach sofortiger Primärnaht. Doch gibt es weitere Argumente nicht-chirurgischer Art. Die äussere, wenn auch nicht totale, Gallendrainage bedeutet einen bedeutsamen Flüssigkeits- und Ionenverlust. Auch ruft das Fehlen der Galle im Darm schwere Resorptionsschäden hervor, welche in erster Linie die Fette betreffen. Der Massenabgang unverdauter Fette ist der Aufnahme sonstiger wertvoller Ingesta (des Eiweisses, des Kalks) nicht dienlich. Noch wichtiger jedoch erscheint das konditionale Defizit der fettlöslichen Vitamine A, D, und K. Von diesen rächt sich manehmal die K-Avitaminose am ehesten, indem der Leber die Prothrombinsynthese unmöglich gemacht wird und Blutungstendenz die Folge ist. Zwar kann neuerdings Vitamin K eingespritzt werden, usw., doch ist damit keineswegs den Gesamtgefahren der Darmacholie vorgebeugt. Man kann gallensaure Salze per os verabreichen, doch bleibt dann noch der Flüssigkeits- und Ionenverlust. Einzugestehen ist allerdings, dass die äussere Gallendrainage die Gelbsucht am schnellsten beheben könnte, dafür jedoch die Besserung des Allgemeinbefindens verzögert bzw. sogar gefährdet.

Vor etwa zwanzig Jahren wurde vorgeschlagen, jede supraduodenale Choledochotomie in eine Anastomose mit dem Zwölffingerdarm überzuführen (Choledochoduodenostomie). JURASZ gilt als Vorkämpfer dieses Verfahrens, dem auch FLÖRCKEN und VON HABERER freundlich gegenüber standen. Zweifelsohne macht man sich auf diese Weise sofort unabhängig von der Wegsamkeit

der Vaterschen Papille, auch falls diese zunächst ödematös zu schwellen sollte, ohne dafür den äusseren Gallenverlust in Kauf zu nehmen. Doch stattet man in dieser Weise seine Kranken einem inneren, meist nur vorübergehend erforderlichen Drainageerfolg zuliebe endgültig mit einer widernatürlichen Anastomose aus. Das bedeutet keinen ungeschmälerten Gewinn: die Choledochoduodenostomie könnte die Gefahr der Cholangitis heraufbeschwören, umsomehr als der neuen Verbindung ein Sphinktermuskel fehlt. Zwar wurde dieses Risiko anseheinend früher überschätzt anlässlich der Fälle, die eine widernatürliche Anastomose, damals vorwiegend in Krebsfällen, bekamen. Doch überlebt der betreffende Kranke seine Anastomosenoperation durchschnittlich nur einige Monate. Ausserdem hiess es, die Anastomose sei oft nur nicht imstande gewesen, die bestehende Cholangitis zu beheben, was allerdings nicht ihr Hauptzweck doch zweifelsohne ein bedeutsames Nebenziel war. Der Erfolg einer Anastomosenoperation beim Steinleiden müsste dagegen länger — manchmal jahrzehntelang — vorhalten, wenn sie vor der Kritik standhalten sollte. Inwieweit sie Dauerheilungen auch in bezug auf cholangitische Schübe zeitigt, scheint mir vorläufig nicht klargestellt zu sein. Übrigens ist der Weg der ascendierenden Cholangitis klar vorgezeichnet in der Inkontinenz (auch in retrogradem Sinn) der entsprechenden Anastomose. Ergeben sich doch nach der peroralen Barytverabfolgung unbeabsichtigte Kontrast-Choledochohepatikogramme bis in die Leber hinein. Ja, man erlebt ohne Kontrastdarreichung Luftbilder der Gallenwege (besonders beim Gallensteinileus). So scheint mir das Vorgehen JURASZ' und FLÖRCKEN's nicht unbedingt empfehlenswert, jedenfalls nur auf strenge Indikation hin — bei nicht-dehnbarer Papille, mutmasslichem Nachschub von Hepatikussteinchen — als am wenigsten unphysiologisches Verfahren gestattet.

KIRSCHNER hat auf das nachdrücklichste die primäre Choledochusnaht befürwortet. Andere dürften ihm darin nicht so konsequent gefolgt sein. Wegen der immerhin etwas unsicheren Nahtfestigkeit der Choledochuswunde legt er sicherheitshalber ein gezieltes Drän an die Nahtstelle und tamponiert je nach Bedarf das Gallenblasenbett. Wenn die sofortige Choledochusnaht erlaubt und auch möglich sein soll, muss die Papille frei und dehnbar sein; auch müsste es sich wohl — allerdings nicht nach KIRSCHNER — um ziemlich reine Steinfälle handeln. Bei hochfiebernder Cholangitis dürften nur wenige sich zur draina-

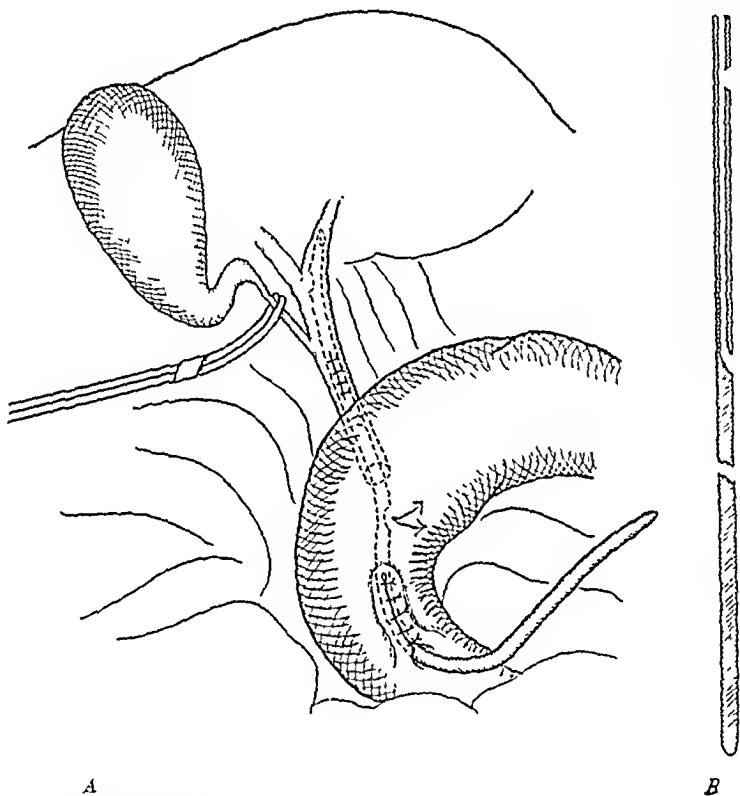
freien Primärnaht des Hauptgallengangs berechtigt fühlen, ich wenigstens nicht ohne Vorbehalt. Auch der untere Choledochus müsste völlig frei, nicht etwa durch eine relative Verhärtung des Pankreaskopfes komprimiert, sein, sonst wäre die innere Anastomose oder die äussere Drainage — solange man den Prozess noch für reversibel hält — erforderlich. Es gibt somit bestimmte Fälle, in denen man die sofortige innere Gallendrainage, jedoch nicht auf dauernd abnormem Wege, sicherstellen möchte. Ferner könnte man sich fragen, inwieweit ein entsprechendes Vorgehen wohl öfter als Sicherheitsmassnahme ohne zwingenden Grund als Zusatz zur primären Choledochusnaht zu befürworten wäre.

In dieser Angelegenheit fiel mir zunächst die Einlegung eines Choledochus-Hepatikusdräns als versenkte mutmassliche Dauerprothese ein oder eher das durch die Papille absichtlich heruntergeführte Hepatikusdrän, die DUVAL'sche »Drainage transvatérien par tube perdu«, altbekannt auch von der sog. Wiederherstellungschirurgie der Gallenwege, insbesondere des Hauptgallengangs, her. Bekanntlich lässt sich über einem solchen Drän sogar Zirkulärnaht des Hauptgallengangs nach (operativ gesetzten) Defekten ausführen. So ein Dränrohr sichert vorläufig die innere Gallendrainage; man erhofft allerdings offen gestanden oder im Stillen, es möge nach einiger Zeit, nicht zu früh, in den Darm abgehen. Nicht immer geht diese Hoffnung in Erfüllung, es bleibt dann ein recht unerwünschter Fremdkörper dauernd im Choledochus zurück und ein Steinrezidiv, ganz besonders auch die Cholangitis recidivans, ist zu befürchten. VÖLCKER hat dem damals abgeholfen, dadurch dass er seine transduodenale Hepatikusdrainage schuf; der Gedanke, die äussere Gallenableitung zu umgehen, hat ihm dabei nicht vorgeschwebt. VÖLCKER legte das Hepatikusdrän durch die Papille hindurch in den Zwölffingerdarm, schnitt auf die Dränspitze ein, zog das Drän hervor und nähte den Austritt desselben aus dem Duodenum nach WITZEL schief ein (analog der transgastrischen WITZEL'schen Jejunostomie). Das Dränrohr wurde durch die Bauchwand herausgeleitet. Nach wenigen Tagen äusserer Gallenableitung — inzwischen konnte die Choledochusnaht verheilen — entfernte er das Drän. Weder Galle noch Duodenalinhalt sickerten dann nachher hinaus, und es resultierte nichts mehr oder weniger als eine annähernde Restitutio ad integrum. Dieses Verfahren legte ich meinem gelegentlichen Vorgehen bei der Choledochotomie wegen Steinkrankheit zugrunde.

Nach erfolgter Choledochotomie, die ich meist der Cholezystektomie nach KIRSCHNER'schem Vorbild voranschicke, und sorgfältiger Entleerung des Hauptgallengangs wird die Papille auf ihre Durchgängigkeit geprüft und mit Bougies dilatiert. Ein Hepatikusdrän wird in den Choledochus eingelegt und mittels einer Steinzange in den Zwölffingerdarm — durch die Papille hindurch — gegen dessen Vorderwand geführt. Auf die Dränspitze wird eingeschnitten, das Drän hervorgezogen und im Duodenum mit einer seitlichen Öffnung versehen, damit die innere, duodenale Gallenableitung sofort möglich sei, und schliesslich nach WITZEL durch einen Schrägkanal herausgeleitet. Die Ränder der Choledochotomiewunde werden mit Katgut adaptiert und über denselben die benachbarten Peritoneallappen. Es erfolgt nunmehr die Cholezystektomie. Nachdem sich gezeigt hat, dass alles wie beabsichtigt geschehen ist (es muss klare Lebergalle abtropfen), wird nach der Bauchwandnaht die äussere Öffnung des durch eine besondere Stichöffnung herausgeführten Dräns durch eine Klemme dauernd verschlossen. Es bleibt nur die innere, gesicherte duodenale Dränage schmerzfrei tätig. Neben dieser ist weitere Sicherheitsdränage überflüssig es sei denn die Dränage im Falle eines Abszesses. Tamponade ist wohl nur bei parenchymatöser Leberbettblutung unumgänglich. Etwa nach einer Woche, inzwischen sind längst nicht mehr entfärbte, acholische Fäzes abgegangen, wird das Dränrohr an dem verschlossenen äusseren Ende herausgezogen und anstandslos entfernt. Die Entfieberung cholangitischer Fälle findet auf diese Weise ohne äussere Gallenableitung statt, manchmal sogar kritisch.

Die Kranken werden nicht durch Flüssigkeitsverlust usw. geschädigt, kommen nicht so sehr herunter, der Appetit bessert sich sofort und nachhaltig. Man bedarf kaum der parenteralen Hilfeleistung; von den Vitaminen dürfte jedoch — allerdings mehr als Vorbereitung — die Einspritzung des antihämorrhagisch wirksamen K manchmal erforderlich sein. Nur eins könnte man der ausschliesslichen inneren Gallenableitung vorwerfen: die Entfärbung der Kranken könnte nicht so schnell vonstatten gehen, die Gelbsucht nicht so bald schwinden, wie bei äusserer Dränage. Daran ist die Tatsache schuld, dass der hepato-enterische Kreislauf der Galle sofort wiederhergestellt wird. Doch leidet das Allgemeinbefinden dabei nicht; die Operierten kommen eher aus dem Bett als sonst. Gegebenenfalls könnte man das Drän auch transgastrisch nach WITZEL herausleiten indem man dasselbe durch den Pfört-

ner hindurch mit einer Steinzange im Duodenum ergreift und hervorzieht. Dies entspricht dem KIRSCHNER'schen Vorschlag für die Einfügung einer Interimsprothese beim zu überbrückenden Choledochusdefekt. Man trage dann allerdings Sorge dafür, dass die seitliche Öffnung des Dränrohrs im Zwölffingerdarm liegt und verankere das Drän dementsprechend mit Katgut an einer der Witzelnähte am besten auch noch an der Bauchhaut.



A. Situationsschema.

B. Spezialdrän im Längsschnitt (durch Unterbrechung gekürzt).

Es ist ersichtlich, dass das Drän nur Leberwärts von der seitlichen Öffnung im Duodenum hohl zu sein braucht; jenseits könnte der nach aussen führende Teil solide sein. Die Anwendung einer Verschlussklemme am äusseren Ende würde sich dann erübrigen, und falls man sich von der richtigen duodenalen Lage des Dränages durch den Tastbefund überzeugt hat, ist die Überprüfung am äusseren Abtropfen der Lebergalle überflüssig. Bei der Verwendung eines solchen, auf meine Veranlassung hingestellten, teilweise soliden Dräns dient der äussere solide Teil ausschliesslich dazu, an ihm den hohlen hepatico-duodenalen Abschnitt hervorzuziehen. Man muss allerdings mein Spezialdrän

auf der Leberseite dem Einzelfall entsprechend kürzen, die Stelle des Dränages ist von vornherein festgelegt.

Mir scheint, dass die nicht-versenkte duodenale Hepatikusdrainage auf transduodenalem bzw. transgastrischem Wege in der Chirurgie der Gallensteinkrankheit ein unzweifelhaftes Anwendungsbereich hat. Sie eignet sich aus klinisch-chemischen Gründen — damit der Gallenverlust gar nicht eintritt — ganz besonders für infizierte, hochfiebernde Fälle, indem sie ihren Zweck verfolgt ohne einen Dauerschaden (widernatürliche Anastomose) zu setzen und auch ohne die Gefahr einer nicht ganz sicheren Choledochusprimärnaht heraufzubeschwören. Sie ist jedoch auch angebracht als überlegenes Konkurrenzverfahren in reinen Choledochotomiefällen an Stelle der sofortigen Naht der Choledochotomiewunde mit gezieltem Sicherheitsdrän an die gelegentlich nicht voll befriedigende Nahtstelle; schaltet sie doch wenigstens vorläufig Komplikationen seitens etwaiger Sphinkterdyskinesie aus. (Diese Erwägung spielte bei FLÖRCKEN auch eine bedentsame Rolle). Deshalb entferne ich das Drän nicht vor der Entfieberung, und sollte diese auch über eine Woche auf sich warten lassen. Wie oft man sich auf die Primärnaht des Hauptgallengangs nur mit gezieltem Sicherheitsdrän verlassen will, bleibe dem einzelnen Chirurgen überlassen: ich selber ziehe im Zweifelsfall das allerdings umständlichere Verfahren der transpapillären duodenalen Gallenablenkung (etwa mit Spezialdrän) unbedingt vor. Eher möchte ich mein Vorgehen systematisieren, als gelegentlich auf die althergebrachte, auch von KIRSCHNER als überholt betrachtete äussere Hepatikus-Choledochusdrainage zurückzugreifen. Deren Indikation erkenne ich auf keinen Fall mehr an. Ganz besonders angezeigt erscheint die transpapilläre Gallendrainage in denjenigen Fällen, wo Choledochus-Papillensteine (auch) auf transduodenalem Wege angegangen wurden.

Doch gibt es noch andere Verwendungsmöglichkeiten meines Verfahrens. Bei der chronisch-entzündlichen Verhärtung des Pankreaskopfes hatte man bisher die Wahl: zeitweilige, allerdings länger dauernde T-Drainage des Hauptgallengangs oder endgültige Anastomose. Hier ist meine Methode dazu berufen, der schwierigen Entscheidung: zunächst monatelanger (allerdings wohl nur teilweiser) Gallenverlust oder endgültige Cholangitissgefahr, aus dem Wege zu gehen. Auch in der Wiederherstellungschirurgie der Gallenwege wäre nach meinem Vorbild von der transduodenalen bzw. transgastrischen somit äusseren Gallenab-

leitung Abstand zu nehmen zugunsten der Dränage in den Magen bzw. Zwölffingerdarm auf meinem transgastrischen (transduodenalen) Wege nach WITZEL.

Schliesslich könnte eine analoge Gallendränage herangezogen werden bei der Herstellung sonstiger Kommunikationen der Gallenwege mit dem Magendarmtrakt: nach Papillenexzision, bei innerer Choledochoduodenostomie, bei bleistiftschmaler Gallenblasenanastomose.

Ich hatte noch nicht die Gelegenheit (Kriegsverhältnisse: Fettkarenz) die Choledochotomie als Hauptmoment in der Behandlung der akuten Pankreasnekrose im Frühstadium auf meine Weise zu beenden. In solchen Fällen wäre eine gewisse Zurückhaltung erklärlich: Gefahr der Nahtandauung. Das transpapilläre Dränrohr nicht zu starken Kalibers gefährdet erfahrungsgemäss das Pankreas nicht durch Kompression des Wirsungianus.

Zusammenfassung.

Als Zusatz zur »idealen Choledochotomie«, zur sofortigen Naht der Choledochotomiewunde empfiehlt sich in entsprechenden (cholangitischen) Fällen, doch auch sonst wohl öfters die nicht versenkte Hepatikus-(Choledochus)-Dränage durch die Papille hindurch in den Zwölffingerdarm mittels eines Spezialdräns. Man leitet dasselbe mit seinem soliden, peripheren Teil auf WITZEL'sche Art aus dem Duodenum (bzw. Magen) und der Bauchwand heraus um daran den hohlen, zentralen, dränierenden hepaticoduodenalen Abschnitt hervorziehen (und beliebig entfernen) zu können. Als Notbehelf sind abgeklemmte gewöhnliche Dräns verwendbar. Sonstige sog. Sicherheitsdräns sind überflüssig. Unter Heranziehung dieses Verfahrens sollte die zeitweilige äussere Gallenableitung auch in Gestalt des gewöhnlichen Hepatikusdräns endlich aus dem chirurgischen Rüstzeug völlig ausscheiden.

Summary.

It is recommended that "ideal Choledochotomy", the immediate suture of the incision in the common bile duct, be followed in certain cases (for instance of cholangitis), but perhaps also in others, by drainage of the hepatic-common duct through the papilla of Vater into the Duodenum. A special non-buried drain

is used. The massive, peripheral portion of this drainage tube is led, after WITZELS method, from the duodenum (or stomach respectively) through the wall of the abdomen, so that with it the hollow, central, draining hepaticoduodenal portion may be drawn out (and in this way removed at any time). Another expedient is to use ordinary but clamped drains. Other so-called "safety"-drains are not necessary. By this method the temporary external bile drainage by means of the usual hepatic tube should ultimately disappear entirely from operative surgery.

Résumé.

Il importe, dans des cas spécialement indiqués (avec cholangite), mais peut-être aussi dans d'autres cas, d'ajouter à la «cholédochotomie idéale» — la suture directe de l'incision dans le cholédoque — le drainage transvatérien vers le duodénum à l'aide d'un tube non perdu. L'on conduit le drain spécial avec la partie périphérique massive selon Witzel du duodénum (resp. de l'estomac) par la paroi abdominale en dehors, afin de pouvoir ainsi extraire la partie creuse centrale, drainante hépaticoduodénale (et par là alors de pouvoir l'enlever à volonté). On peut se contenter de drains simples fermés. A côté de cela les drains de sûreté sont superflus. Avec cette manière de traiter, le drainage temporel extérieur des voies biliaires dans la forme du drain hépatique simple dut enfin disparaître entièrement de l'arsenal chirurgical.

Schrifttum.

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Aus dem Medizinisch-chemischen Institut der Universität Helsingfors.
(Vorstand: Prof. P. E. SIMOLA.)

Über den Wert der Citronensäurebestimmung im Blutserum für die Differentialdiagnose bei Erkrankungen der Leber und der Gallenwege.

Von

LARS HAGELSTAM.

Die Citronensäure (weiter unten wird die Verkürzung Ci verwendet) ist eine in der lebenden Natur allgemein vorkommende Tri-Karbonsäure. Nachdem sie früher als eine für die Medizin belanglose Pflanzensäure betrachtet worden war, hat man auf Grund einer von Physiologen und Biochemikern während der letzten 15 Jahre betriebenen intensiven Forschungsarbeit herausgefunden, dass die Ci eine zentrale Stelle im tierischen Stoffwechsel einnimmt. Im Jahre 1929 publizierte T. THUNBERG seine enzymatisch-chemische Methode zur Bestimmung der Ci. Unter Anwendung dieser Methode sind dann vor allem am Physiologischen Institut in Lund eine Reihe von Arbeiten über das Vorkommen der Ci im Organismus und ihre Bedeutung für denselben ausgeführt worden. Diese Verhältnisse sind kürzlich eingehend von J. MÅRTENSSON (1940) und N. HALLMAN (1940) beschrieben worden, weshalb hier nur auf ihre Arbeiten verwiesen wird.

Grösseres Interesse für die klinische Medizin erlangte die Ci durch die Arbeit P. Sjöströms (1937) über die Bestimmung des Ci-Gehalts im Blutserum als Diagnostikum bei Erkrankungen

Die Untersuchung, deren Ergebnisse hier vorgelegt werden, wurde in den Jahren 1938—39 an einem klinischen Material aus der chirurgischen und medizinischen Abteilung des Allgemeinen Krankenhauses zu Helsingfors, aus dem Maria- und Kivelä (*Stengård*)-Krankenhaus der Stadt Helsingfors, dem Krankenhaus der Diakonissenanstalt zu Helsingfors und dem Finnischen Roten-Kreuz-Krankenhaus ausgeführt. Bei der Sitzung von Finska Läkaresällskapet am 8. Mai 1941 wurde über das Resultat der Untersuchung Bericht erstattet. Die Arbeit wurde auf Grund des Krieges unterbrochen und die Publikation hat sich aus demselben Grunde verzögert.

der Leber und der Gallenwege. (Der Ci-Gehalt im Blutserum wird anschliessend mit Ci/s bezeichnet und in γ /ml ausgedrückt). SJÖSTRÖM fand, dass die Normalwerte bei 160 gesunden Personen zwischen 17 und 27 γ /ml lagen. Als Mittelwert stellte er 20.52 ± 1.80 fest. Unter ca 300 Patienten mit Erkrankungen der Leber oder der Gallenwege wiesen die Fälle mit akuter Hepatitis in 79 % gesteigerte Ci-Werte auf. Bei chronischer Hepatitis und Zirrhose lagen 81 % der Werte über 25 γ /ml und 63 % über 27 γ /ml. Die unkomplizierte Cholecystopathie bot in der Regel normale Werte dar. Er untersuchte 65 Fälle mit Steinen im Ductus choledochus: $\frac{4}{5}$ der in einer schmerzfreien Periode entnommenen Proben wiesen normale Werte auf, während die während eines Schmerzanfalls entnommenen Proben oft eine leichte Steigerung des Ci-Wertes darboten. Die Fälle mit Karzinom in den Gallenwegen oder im Pankreas wiesen zu einem noch grösseren Teil normale Werte auf. Die Bestimmungen an Fällen mit Lebertumor ergaben wechselnde Resultate. SJÖSTRÖM bediente sich der von T. THUXBERG (1933) erwähnten Ci-Belastung. Die perorale Zufuhr von 2 g Ci ergab in Fällen von Obturationsikterus nur ein rasch vorübergehender Anstieg des Ci/s, während bei Hepatitispatienten eine langdauernde Steigerung festgestellt wurde, die nach 2 Std. noch nicht zurückgegangen war. SJÖSTRÖM fand, dass die Belastungsprobe der Untersuchungsmethode erhöhten Wert verlieh. Er zog die Schlussfolgerung, dass die Bestimmung des Ci/s im Blutserum bei unklaren Ikterusfällen oft wertvolle Aufschlüsse für das Stellen der Differentialdiagnose zwischen Hepatitis und Obturationsikterus auch in solchen Fällen liefert, wo andere Leberfunktionsprüfungen im Stich gelassen haben.

Die Ci-Bestimmung wurde von J. LEHMANN aufgenommen, der dieselbe mit der Phosphatasebestimmung im Blutserum kombinierte. Die Ergebnisse legte er i. J. 1939 vor (J. LEHMANN 1940). Gleichzeitig berichtete M. ODIN (1940) über das Resultat vergleichender Leberfunktionsprüfungen bei einer Anzahl sicherer Fälle von Hepatitis. Die Takata-Ara-Reaktion war in 42 % (29 von 64), die gewöhnliche Galaktoseprobe in 56 % (25 von 45), die Galaktoseprobe nach Pollak in 83 % (35 von 41) und die Ci-Probe auch in 83 % (54 von 65) dieser Fälle positiv. ODIN betonte, dass die Proben einander nicht ersetzen sondern ergänzen und schloss sich LEHMANN darin an, dass die Kombination der Ci- und Phosphatasebestimmung in den meisten Fällen eine Antwort auf die Frage: Hepatitis oder Obturationsikterus? zu geben vermag.

Ein hoher Ci- und ein niedriger Phosphatasewert sprechen für Hepatitis, ein niedriger Ci- und ein hoher Phosphatasewert sprechen ebenso deutlich für Obturationsikterus. LEHMANN kam i. J. 1941 (J. LEHMANN 1941) auf die Frage zurück, wo er das Ergebnis vergleichender Bestimmungen des Ci-, Phosphatase- und Ikterusindex an 450 Patienten mit Erkrankungen der Leber oder der Gallenwege vorlegte. Das Laboratorium lieferte in 90 % der Fälle die richtige Differentialdiagnose inbetreff des Ikterusursprungs. LEHMANN setzte die Norm für den Ci/s auf 20—28 γ /ml an und sprach von Hepatitiswerten über 28 γ /ml.

Die Kombination der Serumphosphatase-, Serum-Ci- und Takata-Ara-Bestimmung bei Erkrankungen der Leber und der Gallenwege wurde von H. BUCH (1942) beschrieben. Den Normalwert für Ci/s stellte er bei 32 Personen zu 15.3—25.8 γ /ml fest; das Mittel betrug 20.2 γ /ml. Unter 31 Fällen mit Choledocholithiasis wiesen nur 8 in irgendeiner Phase der Krankheit Ci-Werte über 27 γ /ml auf. Unter 29 Fällen von Cholelithiasis mit Ikterus fand er einen gesteigerten Ci-Gehalt lediglich in 7 Fällen; Cholelithiasis sine ictero verlief mit normalen Ci-Werten. Tumoren der Gallenwege und des Pankreas ohne Metastasen waren durch 6 Fälle vertreten, nur 2 hatten in allen Phasen der Krankheit normale Ci-Werte, während 7 von den 8 Fällen mit Metastasen normale Werte darboten. 21 sichere Hepatitisfälle hatten sämtlich gesteigerte Ci-Werte. BUCH bestätigte die LEHMANNsche Regel von der Beziehung zwischen der Ci- und der Phosphataseprobe bei Erkrankungen der Leber und der Gallenwege.

Bezüglich der Frage, weshalb die Bestimmung der Serum-Ci als Leberfunktionsprobe verwendet werden kann, äusserte J. MÅRTENSSON (1940): »Obgleich der Ci-Gehalt im Serum normalerweise ziemlich konstant liegt, reagiert er doch sehr empfindlich auf Änderungen der quantitativen Verhältnisse bei den Reaktionen, an denen die Ci teilnimmt. Dies deshalb, weil der Gehalt im Serum so niedrig ist, kaum mehr als 0.0001 mol, und weil Ci eine Substanz ist, die sehr leicht abgebaut wird. Der Abbau der Ci erfolgt hauptsächlich im Nierenparenchym. Aber der Ci-Umsatz ist eng verbunden mit Prozessen innerhalb des Kohlehydrat- und Eiweissmetabolismus, welche direkt vom funktionellen Zustand der Leber abhängig sind. Deshalb können wir die Serum-Ci als empfindlichen Indikator der Leberfunktion anwenden, da wir die Möglichkeit besitzen, auch kleinere Variationen im Ci-Gehalt des Serums exakt zu bestimmen«.

Methodik.

Für die Ci-Bestimmungen ist die enzymatisch-chemische Methode nach THUNBERG zur Anwendung gekommen. Die Blutproben wurden morgens auf nüchternen Magen steril durch Venenpunktion entnommen. Die Proben wurden im Eisschrank aufbewahrt

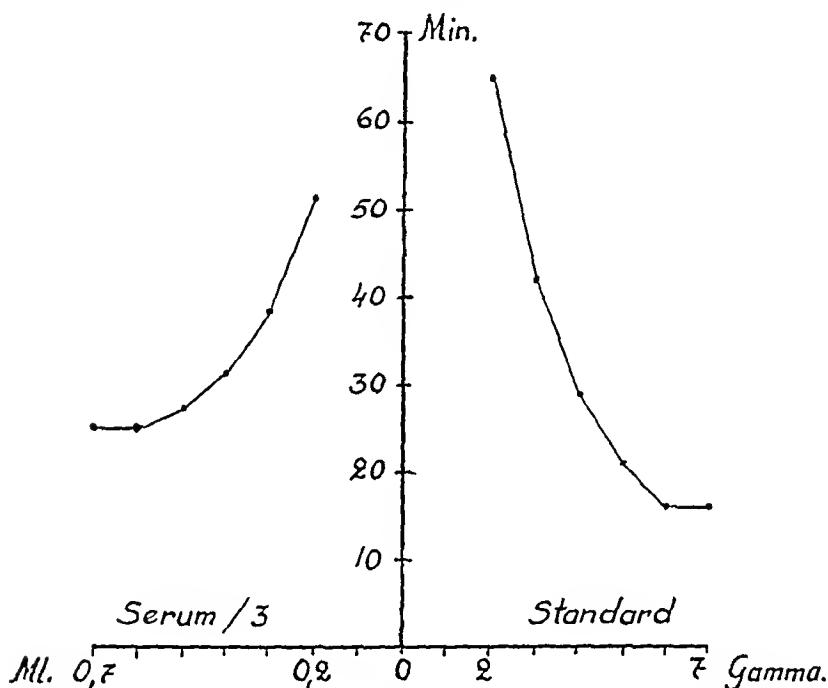


Fig. 1.

Berechnung: Das Röhrchen mit 0.2 ml Serumverdünnung ergibt 39.00, mit 0.3 — 32.00, mit 0.4 — 29.25, mit 0.5 — 25.20 und mit 0.6 — 22.50 γ /ml. Das Mittel für die Röhrchen mit 0.3, 0.4 und 0.5 ml beträgt 28.8 γ /ml.

und in der Regel an demselben oder am folgenden Tage untersucht. Kontrollproben erwiesen, dass die Aufbewahrung der Proben ihren Ci-Gehalt nicht veränderte. Die verschiedenen Entfärbungszeiten der Standard- und Serumröhrchen sind in üblicher Weise in ein Koordinatensystem eingetragen worden (s. Fig. 1). Der Ci-Wert wurde nach THUNBERG ausgehend von dem Prinzip berechnet, dass gleich langen Entfärbungszeiten in der Serum- und in der Standardserie gleich grosse Ci-Mengen entsprechen. Der Wert für Ci/s ist als Mittel der aus den Röhrchen mit 0.3, 0.4 und 0.5 ml Serumverdünnung berechneten Ci-Werte angegeben.

Tabelle 1.

Kontrolle der Differenz zwischen zwei Bestimmungen
an derselben Serumprobe.

Versuch Nr	Serum- verdünnung	Erste Bestim- mung	Zweite Bestim- mung	Differenz im Mikrogramm	Differenz in % des Mittelwertes der Bestim- mungen	Arithmetisches Mittel	Arithmetisches Mittel unter Ausschluss von Versuch 24
1	1/5	44.00	45.03	1.03	2.31		
2	1/5	52.53	53.50	0.97	1.83		
3	1/5	50.69	48.39	2.30	4.64		
4	1/5	46.81	43.28	3.53	7.86		
5	1/4.5	45.80	46.55	0.75	1.62		
6	1/4.5	40.98	42.60	1.62	3.88		
7	1/4.5	41.10	43.95	2.85	6.70		
8	1/4	56.33	51.50	4.83	8.96		
9	1/4	39.24	38.09	1.15	2.97		
10	1/4	42.87	40.11	2.76	6.65		
11	1/3.5	50.32	46.09	4.23	8.77		
12	1/3.5	28.62	31.29	2.67	8.91		
13	1/3.5	33.72	35.41	1.69	4.89		
14	1/3.5	37.78	37.26	0.56	1.49	5.11 %	
15	1/3	25.72	25.58	0.14	0.55		
16	1/3	26.95	27.02	0.07	0.26		
17	1/3	28.20	29.13	0.93	3.24		
18	1/3	18.83	18.73	0.10	0.53		
19	1/3	28.05	27.67	0.38	1.36		
20	1/3	26.42	26.30	0.12	0.46		
21	1/3	28.58	28.05	0.53	1.87		
22	1/3	21.40	20.77	0.63	2.99		
23	1/3	36.25	35.57	0.68	1.89		
24	1/3	29.23	25.43	3.80	13.90		
25	1/3	27.20	27.98	0.78	2.83		
26	1/2.5	19.79	19.69	0.10	0.51		
27	1/2.5	16.57	16.57	0.00	0.00		
28	1/2	18.74	18.02	0.72	3.92	2.45 %	1.57 %
						3.78 %	3.40 %

Die Differenz zwischen zwei Bestimmungen an derselben Serumprobe ist durch 28 Doppelbestimmungen berechnet worden. Von diesen wurden 7 an demselben Tage bei zwei verschiedenen Versuchen, die übrigen an verschiedenen Tagen ausgeführt. Die Ergebnisse gehen aus Tab. 1 hervor. Es ist anzunehmen, dass sich in Versuch 24 (Tab. 1) ein grösserer technischer Fehler eingeschlichen hat, da das Ergebnis bei diesem Versuch so stark von den übrigen abweicht. In der Tabelle sind die Versuche nach fallenden Verdünnungszahlen gruppiert worden, da zu erwarten ist, dass die grössten Differenzen bei den stärksten Verdünnungen

entstehen werden, weil ja die Verdünnungszahl als Multiplikationsfaktor in die Formel für die Berechnung des Ci/s -Wertes aus der Kurve eingeht. Diese Annahme erwies sich als berechtigt. Für jeden einzelnen Versuch ist die Differenz zwischen den zwei Bestimmungen in % des Mittels der Bestimmungen berechnet worden. Im Mittel hat die Differenz 3,78 % betragen, wenn man von Versuch 24 absieht betrug sie 3.40 %. In den 14 Versuchen, wo das Serum mehr als dreimal verdünnt war, belief sich die Differenz auf 5.11 %, und in den 14 Versuchen, wo das Serum dreimal oder weniger verdünnt war, auf 2.45 %. Unter Ausschluss von Versuch 24 erhalten wir für die letztgenannte Gruppe die Zahl 1.57 %.

Bei Verwendung der THUNBERG-Methode zur Bestimmung der Ci in verschiedenen Körperflüssigkeiten begegnet man einem Phänomen, das anseheinend eine beachtenswerte Fehlerquelle ausmachen kann. Am stärksten dürfte sich dies Phänomen beim Arbeiten mit Blutserum geltend machen. Ich denke hierbei an die sog. systematische Deviation der Serumkurve. Dieselbe ist daran schuld, dass man beim Berechnen der Ci -Werte aus der Kurve regelmässig einen um so höheren Wert erhält, eine je geringere Menge Serumverdünnung in dem Röhrchen enthalten ist, während der Wert mit steigender Serummenge im Röhrchen sinkt (vgl. Fig. 1). Insbesondere bei Serumproben mit niedrigem Ci -Gehalt, die nur wenig verdünnt werden, macht sich das Phänomen stark geltend. Eine endgültige Erklärung für die Ursache des Phänomens ist noch nicht abgegeben worden. Ungesucht stellt sich der Verdacht ein, dass der berechnete Wert vielleicht nicht richtig ist, da man aus verschiedenen ausgewählten aufeinanderfolgenden Punkten der Serumkurve verschiedene Mittelwerte berechnen kann. Wie erwähnt, habe ich den Mittelwert der aus den Röhrchen mit 0.3, 0.4 und 0.5 ml Serumverdünnung berechneten Ci -Werte als Ci/s angegeben. Es ist wichtig zu wissen, ob sich auf diese Weise ein systematischer Fehler einschleicht, und in dem Fall, wie gross dieser Fehler ist. Das Problem ist auf zwei verschiedenen Wegen angegangen worden.

1. Bestimmung der Ausbeute eines bekannten Ci -Zusatzes zum Serum.

Das Verfahren erhellt aus folgendem Beispiel: Ci/s wurde in einer Serumprobe zu 25.83 γ/ml festgestellt. Das Serum wurde im Verhältnis 1/2.5 verdünnt, und bei einem neuen Versuch wurde eine Röhrenserie I in üblicher Weise mit dieser Verdünnung

beschickt. Es wurde eine Ci-Lösung bereitet, die 25 γ /ml Ci enthält. Gleiche Teile von Serum und von dieser Ci-Lösung wurden gemischt und das Gemisch im Verhältnis 1/2.5 verdünnt. Der Ci-Gehalt des Gemisches betrug dann

$$\frac{\frac{\text{»Serum«}}{2.5} + \frac{25}{2.5}}{2} \gamma/\text{ml}.$$

Eine Röhrenserie II wurde bei demselben Versuch in üblicher Weise mit dieser Mischung beschickt. Die Kurven I und II wurden sehr ähnlich, da der Ci-Gehalt in den beiden Röhrenserien beinahe derselbe war und beide das gleiche Serum, wenn auch in verschiedener Verdünnung enthielten. Die beiden Kurven wurden mit derselben Standardkurve verglichen. Die Berechnung wurde so bewerkstelligt, dass die Ausbeute der Röhren mit gleichen Quanten Serumverdünnung bzw. Ci-Serumgemisch Paar für Paar miteinander verglichen wurden. Da die beiden Kurven einander beinahe deckten, wirkte der durch die systematische Deviation eventuell eingeführte Fehler in gleichem Masse auf beide Röhren ein. Aus dem Röhren mit 0.4 ml Serumverdünnung in der Röhrenserie I wurde der Ci-Gehalt der Serumverdünnung zu 10.5 γ /ml, und aus dem Röhren mit 0.4 ml Ci-Serumgemisch in der Röhrenserie II der Ci-Gehalt des Gemisches zu 11 γ /ml

berechnet. In der Formel ist dann $\frac{\text{»Serum«}}{2.5} = 10.5$. Der bekannte

Ci-Zusatz betrug ja 10 γ /ml, aber die Ausbeute dieses 10 γ ist uns unbekannt und wird mit x bezeichnet, wobei die Formel das

Aussehen $\frac{10.5 + x}{2}$ erhält. Der Zahlenwert dieses Ausdrucks

wurde oben aus dem Röhren 0.4 in Serie II zu 11.0 berechnet.

Wir erhalten also $\frac{10.5 + x}{2} = 11.0$ und $x = 11.5$. — Auf diese

Weise wurde die Ausbeute der zugesetzten Ci-Menge Röhren für Röhren in 16 Versuchen berechnet, die in Tab. 2 wiedergegeben sind. Diese Versuche lassen erkennen, dass die systematische Deviation der Serumkurve einen systematischen Fehler bei der Berechnung des Ci/s-Wertes verursacht. Die Ausbeute aus dem Röhren mit 0.3 und 0.4 ml Serumverdünnung wird im Mittel um 16.53 bzw 6.25 % zu gross, während die Ausbeute aus dem Röhren mit 0.5 ml Serumverdünnung im Mittel 0.12 %

Tabelle 2.

Ausbeute beim Zusatz von 10 γ /ml Ci zum Serum.

Versuch	Röhrchen mit ml Serum + Ci			Mittel der Röhrchen mit 0.3, 0.4 und 0.5 ml	Mittel der Röhrchen mit 0.4 und 0.5 ml
	0.3	0.4	0.5		
1	13.000	11.000	10.800	11.600	10.900
2	10.666	9.750	9.000	9.805	9.375
3	11.667	13.000	10.800	11.822	11.900
4	13.332	11.500	10.400	11.744	10.950
5	9.000	8.000	7.800	8.267	7.900
6	12.333	10.000	10.000	10.778	10.000
7	10.667	9.500	11.600	10.589	10.550
8	11.666	11.500	10.200	11.122	10.850
9	11.667	10.250	10.000	10.639	10.125
10	11.667	10.500	10.600	10.922	10.550
11	13.000	11.500	10.000	11.500	10.750
12	12.332	11.000	10.600	11.311	10.800
13	12.000	10.500	10.200	10.900	10.350
14	9.667	9.000	9.600	9.422	9.300
15	12.667	12.000	10.400	11.689	11.200
16	11.120	11.000	7.800	9.973	9.400
Arithm. Mittel .	11.653	10.625	9.988	10.755	10.306
Fehler in % . .	16.53	6.25	0.12	7.55	3.06

zu klein ausfällt. Durch Angabe des Zahlenwertes für Ci/s als Mittel der aus den Röhrchen mit 0.4 und 0.5 ml Serumverdünnung berechneten Zahlen wäre man bei diesen Versuchen zu einem annähernd richtigen Ergebnis, 10.3 γ anstatt der zugesetzten 10 γ gekommen. Da aber ein ans nur zwei Röhrchen berechneter Mittelwert durch eventuelle technische Fehler bei der Bestimmung allzu stark beeinflusst werden würde, bin ich dabei geblieben, doch den Mittelwert für die Röhrchen mit 0.3, 0.4 und 0.5 ml Serumverdünnung als Ci/s anzugeben, trotzdem der Wert hierdurch um ca 7.5 % zu gross angegeben wird. Das Röhrchen mit 0.6 ml Serumverdünnung ist bei diesen Berechnungen nicht mitgenommen worden, weil die Entfärbungszeit für die Röhrchen oft die gleiche wie für das Röhrchen mit 0.5 ml war, und eine Berechnung also nicht möglich war.

2. Bestimmung der Ausbeute einer bekannten Ci-Menge, wenn die systematische Deviation durch eine indifferente Elweislösung bedingt ist.

Der Verfasser fand, dass verschiedene Stoffe, die kolloidale Lösungen bilden, eine systematische Deviation der Ci-Kurve

Tabelle 3.

Ausbeute beim Zusatz von 10 γ /ml Ci zu Alb. ovi pulv. in 6 % Lösung.

Versuch	Röhrchen mit ml Alb. ovi + Ci			Mittel der Röhrchen mit 0.3, 0.4 und 0.5 ml	Mittel der Röhrchen mit 0.4 und 0.5 ml
	0.3	0.4	0.5		
1	13.33	11.25	9.80	11.46	10.53
2	11.67	9.75	8.60	10.01	9.18
3	12.67	10.25	9.20	10.77	9.73
4	11.33	10.00	8.40	9.91	9.20
5	13.33	10.75	9.40	11.16	10.08
6	12.00	10.00	9.20	10.40	9.60
7	11.33	10.50	9.40	10.41	9.25
8	10.00	8.75	8.60	9.17	8.68
9	10.67	9.25	8.60	9.51	8.93
10	11.33	9.50	7.60	9.48	8.55
11	11.00	10.00	8.60	9.87	9.30
12	12.00	10.50	9.40	10.63	9.95
13	12.33	10.25	9.60	10.73	9.93
14	11.33	10.00	9.40	10.24	9.70
15	12.00	10.00	9.40	10.47	9.70
16	12.67	10.75	9.00	10.81	9.88
17	9.67	9.25	8.20	9.04	8.73
18	11.00	9.75	8.60	9.78	9.18
19	10.67	9.00	8.20	9.29	8.60
20	11.67	10.50	9.40	10.52	9.95
Arithm. Mittel .	11.60	10.00	9.83	10.18	9.47
Fehler in % . .	16.00	0	1.70	1.80	5.30

hervorrufen. Diese Deviation entspricht vollständig der vom Serum hervorgerufenen. Das erwähnte Phänomen wurde zur Kontrolle der Berechnungsweise für Ci/s ausgenützt. Zu einer 6 % Lösung von Albumen ovi pulverisatum Schering-Kahlbaum wurden 10 γ /ml Ci hinzugefügt und mit dieser Lösung 20 Versuche angestellt. Die Versuche werden in Tab. 3 wiedergegeben. Die Bestimmung mittels der Pentabromacetonmethode nach PUCHER, SHERMAN und VICKERY zeigte, dass die Lösung als solche keine Ci enthält, trotzdem T. THUNBERG (1941) ca 10 γ /ml Ci im Hühner-eiweiss fand. Die in Tab. 3 wiedergegebenen Versuche erweisen, dass die systematische Deviation hier einen Fehler von derselben Grössenordnung einführt wie bei den Versuchen mit Serum (vgl. Tab. 2). Bei den Versuchen mit Eiweisslösung war die Ausbeute für das Röhrchen mit 0.3 ml im Mittel um 16 % zu gross, während sie für das Röhrchen mit 0.4 ml genau richtig 10 γ betrug. Das Röhrchen mit 0.5 ml ergab eine Ausbeute, die im Mittel um 1.70 % zu klein ausfiel. Gibt man bei diesen Versuchen das Mittel der

Ci-Werte für die Röhrechen mit 0.3, 0.4 und 0.5 ml Eiweisslösung als den Ci-Gehalt der Lösung an, so erhält man eine bemerkenswert exakte Ausbeute der zugesetzten Ci-Menge, im Mittel 10.18 γ /ml gegen den richtigen Wert 10 γ , und einen Fehler von nur 1.8 %. Der Mittelwert für die Röhrechen mit 0.4 und 0.5 ml ist bei diesen Versuchen um 5.30 % zu klein. Diese Versuche lassen überdies die Berechtigung einer Verwendung des Mittelwerts für die Röhrechen mit 0.3, 0.4 und 0.5 ml bei der Berechnung von Ci/s erkennen.

Einige vergleichende Untersuchungen mit der Pentabromacetonmethode nach PUCHER, SHERMAN und VICKERY sind in Zusammenarbeit mit KRUSIUS ausgeführt worden. Die Versuche zeigten eine gute Übereinstimmung zwischen den Ergebnissen, sie sind von F. E. KRUSIUS (1940) als Tab. 11 in seiner Abhandlung publiziert worden.

Bei 20 Proben von 20 gesunden Personen lag Ci/s zwischen 19.51 und 28.85 γ /ml, entsprechend einem Mittelwert von 24.35 γ /ml. Als obere Grenze der normalen Werte sind 28 γ /ml angesetzt worden.

Schlussfolgerungen.

1. Die THUNBERG-Methode hat in der Hand des Verfassers eine Differenz von im Mittel 3.78 % des Mittelwertes für zwei Bestimmungen an derselben Serumprobe ergeben.

2. Die systematische Deviation der Serumkurve ist daran schuld, dass der aus den Röhrechen mit 0.3, 0.4 und 0.5 ml Serumverdünnung berechnete Wert für Ci/s ca 7.5 % zu gross ausfällt.

3. Wenn die systematische Deviation durch eine indifferente Eiweisslösung bedingt ist, wird die Ausbeute einer bekannten, aus den Röhrechen mit 0.3, 0.4 und 0.5 ml berechneten Ci-Menge nur 1.8 % zu gross.

Klinische Untersuchungen.

Das klinische Material besteht aus 98 Patienten mit Erkrankungen der Leber oder der Gallenwege. Bei diesen Patienten wurde Ci/s in 186 Proben untersucht. In 9 Fällen blieb die Leberdiagnose unsicher. Bei den restlichen 89 Patienten wurden 168 Proben untersucht. Die Arbeit war als vergleichende Untersuchung über den Wert der Ci-Bestimmung und einiger anderer in der klinischen Routinearbeit gebräuchlichen Leberfunktionsproben

für die Differentialdiagnose zwischen Hepatitis und Obturationsikterus mit besonderer Berücksichtigung des chirurgischen Interesses für die zeitige Operation bei Fällen mit Choledochusstenose geplant. Da die Arbeit in einem zeitigen Stadium unterbrochen wurde, ist das Material recht klein. Zahlenangaben über die Untersuchungsergebnisse bei den oben erwähnten 98 Patienten nebst kurzen Kommentaren findet man in der tabellarischen Aufstellung nach dem Text.

Hepatitis catarrhalis und Atrophia hepatis acuta.

In der Diagnosengruppe Hepatitis catarrhalis sind alle akuten Parenchymschädigungen mit Ausnahme der im Anschluss an Cholecystopathien auftretenden leichten Hepatitiden zusammengestellt, welche letztere der Übersichtlichkeit halber mit den übrigen Cholecystopathien zu einer Gruppe vereinigt wurden. Die Diagnose Atrophia hepatis acuta wurde nur in den Fällen gesetzt, wo die Diagnose durch die Sektion bestätigt worden war. Die Gruppeneinteilung kann summarisch anmuten, entspricht aber hier der praktischen Forderung einer Diagnosengruppe, innerhalb welcher man die Fälle findet, die a priori von einer chirurgischen Therapie ausgeschlossen sind. Die Bezeichnung Hepatitis catarrhalis wird im pathologisch-anatomischen Sinne nach der Terminologie Eppingers aufgefasst.

Die Zahl der geheilten Fälle von katarrhalischer Hepatitis beläuft sich auf 29, bei denen 81 Bestimmungen des Ci/s ausgeführt wurden.

Fall 1—19 waren Fälle von schwerer Hepatitis, bei denen gastrointestinale Symptome bei der Erkrankung dominiert hatten, während die Fälle 20—26 aus Patienten bestehen, deren Krankheitsbild an leichtere Fälle von epidemischer Hepatitis erinnerte. SJÖSTRÖM (1937) führte diese Gruppeneinteilung bei seinem Material durch und fand, dass die Patienten, die unter dominierenden gastrointestinalen Symptomen erkrankt waren, fast durchgehend bedeutend erhöhte Ci-Werte aufwiesen, während die Gruppe der leichteren Fälle eine grössere Anzahl recht niedriger Werte darbot.

Ci/s lag in den Fällen 1—19 bei 48 von 50 Bestimmungen über 28 γ /ml, nur 2 Proben ergaben einen normalen Wert für Ci/s. Diese zwei Proben stammen von Rekonvaleszenten nach Hepatitiden, in deren Verlauf früher bedeutend erhöhte Werte konsta-

tiert werden konnten (Fall 2 und 16). Werte zwischen 28 und 30 γ /ml sind schwer zu deuten, wenn sie nicht gegen den Hintergrund früherer erhöhter Werte bei demselben Kranken betrachtet werden. Solche Werte kommen hier 4 mal vor (Fall 2, 7, 11 und 17). Alle 4 Bestimmungen dieser Grössenordnung finden wir also bei Patienten, bei denen frühere Proben Resultate über 30 γ /ml ergeben hatten. In Fall 7 betrug der Wert der früheren Bestimmung 30.6 γ /ml, und es wäre eine gewisse Unsicherheit bestehen geblieben, wenn nicht eine deutlich pathologische Belastungsprobe erwiesen hätte, dass die Werte von 30 und 28 hier nicht auf einem Zufall beruhten. Bei allen diesen 19 Patienten mit schwerer Hepatitis konnten also wenigstens auf dem Höhepunkt der Erkrankung erhöhte Ci-Werte festgestellt werden.

Unter den Fällen 20—26 finden wir insoweit durchgehend niedrigere Werte als in der vorigen Gruppe, als lediglich Fall 24 mit hohen Werten über 50 einherging, während wir derartige Werte in der vorigen Gruppe in Fall 2, 3, 4, 5, 9, 10, 12, 15, 16 und 18 wiederfinden. Normale Werte werden in dieser Gruppe nur in zwei Proben von Fall 21 und 25 nachgewiesen; beide Bestimmungen wurden in der Rekonvaleszenz ausgeführt. Schwer deutbare Werte zwischen 28 und 30 werden in einer Anzahl von drei in den Fällen 20, 22 und 25 angetroffen. In Fall 20 handelt es sich jedoch um einen Ausgangswert, auf den später deutlich gesteigerte Werte folgten; in den beiden anderen Fällen wurden die betreffenden Bestimmungen in der Rekonvaleszenz ausgeführt. In Fall 27, 28 und 29 haben sämtliche Bestimmungen des Ci/s einschliesslich der Belastungsproben normale Werte ergeben. Alle drei Patienten waren junge Männer, die sehr leicht ohne Fieber oder gastro-intestinale Symptome an flüchtigem Ikterus erkrankt waren. Die klinische Diagnose lautete katarrhalische bzw. epidemische Hepatitis. Allem Anschein nach hat es sich um sehr leichte Formen von epidemischer Hepatitis gehandelt. Das negative Resultat der Ci-Probe in diesen Fällen stimmt gut mit der Erfahrung Sjöströms (1937) mit der Probe bei epidemischer Hepatitis überein.

Der unerwartet hohe Wert, 125.7 γ /ml in Fall 2 bereitete zunächst Deutungsschwierigkeiten, da ihm keine Verschlechterung im Zustand des Patienten entsprach, der im Gegenteil eine Besserung erfuhr. Eine nähere Analyse ergab, dass der Kranke kurz vor der Probenentnahme wenigstens ein Glas Preisselbeersaft zu sich genommen hatte, das grosse Mengen Ci enthalten dürfte. Es liegen Untersuchungen vor, die das Vorkommen grosser Mengen

Ci in einer Anzahl Beeren- und Fruchtsäften ausweisen. Diese Probe ist als eine unfreiwillige Belastungsprobe zu betrachten und weist darauf hin, wie wichtig es ist, dass der Kranke am Morgen vor Entnahme der Probe wirklich gar nichts verzehrt. Ist die Kontrolle in dieser Hinsicht mangelhaft, so wird das Ergebnis in Frage gestellt.

Die drei Fälle von katarrhalischer Hepatitis, die ad exitum führten, findet man unter Nr. 30, 31 und 32, die drei Fälle von akuter Leberatrophie unter Nr. 33, 34 und 35. Unter den 9 diesen 6 Patienten entnommenen Proben haben nur 2 Proben, Fall 34 und 35, Werte unter 50 γ /ml dargeboten. In Fall 34 lieferte eine Belastungsprobe einen stark gesteigerten Wert. Die Bestimmung des Ci/s hat also bei diesen Fällen mit schweren parenchymatösen Leberveränderungen eindeutig positive Resultate ergeben.

Aus der tabellarischen Aufstellung geht auch das Ergebnis der vergleichenden Untersuchungen hervor, die zwischen dem Ci/s einerseits und der Galaktoseprobe, der Adrenalinblutzucker-Kurve und der Takata-Probe anderseits angestellt wurden. Die Galaktoseprobe ist in üblicher Weise mittels Zufuhr von 40 g Galaktose per os ausgeführt worden. Eine Ausscheidung von 3 g oder darüber ist als pathologisch angegeben worden. Bezüglich näherer Angaben über die Adrenalinblutzucker-Kurve (unten als Adrenalinprobe bezeichnet) wird auf die Arbeit LÖVEGREN (1942) verwiesen, in der man alle nachstehend angeführten Adrenalinproben wiederfindet. Als pathologisch ist nach LÖVEGREN eine Blutzuckerdiffferenz von höchstens 40 mg% angesprochen worden. Unsichere Werte zwischen 40 und 45 mg% sind in dem Hepatitismaterial nicht vorgekommen. Eine Differenz über 45 mg% ist als normal aufgeführt. Die Takata-Probe wurde nach HAFSTRÖM (1935) ausgeführt und abgelesen, ein flockiger Niederschlag in einem Röhrchen wurde als positive Reaktion bezeichnet. Die Takata-Probe ist an derselben Serumprobe wie die Ci-Bestimmung angestellt worden, während die Galaktose- und die Adrenalinproben in der chronologischen tabellarischen Aufstellung neben den in derselben Woche ausgeführten Bestimmungen des Ci/s angegeben sind.

Die Galaktoseprobe ist parallel mit der Ci/s-Bestimmung 20 mal an 15 Patienten mit katarrhalischer Hepatitis oder akuter Leberatrophie angestellt worden. Beide Proben waren 6 mal positiv, während 11 mal positiven Ci-Bestimmungen negative Galaktoseproben entsprachen. In keinem Fall hat sich die Galaktoseprobe

als empfindlicher denn die Ci-Bestimmung erwiesen; sie erwies sich im Gegenteil nur in etwa der Hälfte der Fälle als gleich anwendbar. Drei Galaktoseproben in Fall 1, 12 und 16 waren nicht direkt mit irgendeiner Ci-Probe zu vergleichen.

Die Adrenalinprobe wurde 8 mal an 8 Patienten in derselben Diagnosengruppe parallel mit der Ci-Bestimmung ausgeführt. Beide Proben waren 7 mal positiv, während es einmal vorkam, dass die Adrenalinprobe neben einer negativen Ci-Probe positiv ausfiel. Dies wurde in Fall 21 während der Rekonvaleszenz konstatiert. Die Adrenalinprobe erwies sich in diesem Fall im Vergleich zu der Ci-Bestimmung sogar als empfindlicher.

Die Takata-Probe ist, wie erwartet, bei diesen akuten Hepatiden schlecht ausgefallen. Sowohl die Ci-Bestimmung als die Takata-Probe waren 14 mal positiv; 6 von diesen Resultaten stammen jedoch von demselben Patienten, Fall 3. Zweimal waren beide Proben negativ. Volle 14 mal entsprach einer positive Ci-Probe eine negative Takata-Probe.

Bei den untersuchten 32 Fällen von katarrhalischer Hepatitis und den drei Fällen von akuter Leberatrophie hat sich die Ci-Bestimmung im Blutserum als eine sehr selektive Leberfunktionsprobe erwiesen, die abgesehen von drei Fällen mit sehr leichter Hepatitis wenigstens während des Höhestadiums der Krankheit ein positives Resultat geliefert hat. Es stellte sich heraus, dass die Probe bedeutend empfindlicher als die Galaktose- und die Takata-Probe ist, während die Adrenalinprobe wohl als ebenso empfindlich wie die Ci-Bestimmung angesprochen werden muss.

Cirrhosis hepatis.

Die Diagnosengruppe wird nur von 2 Fällen repräsentiert (Nr 36 und 37); der eine wurde bei der Operation, der andere durch die Sektion bestätigt. Bei diesen zwei Patienten wurden 7 Proben untersucht, die sämtlich gesteigerte Ci-Werte darboten. In beiden Fällen war Takata positiv. Die Galaktoseprobe fiel bei zwei Untersuchungen in Fall 36 negativ aus.

Fall 37 besitzt chirurgisches Interesse. Der Patient erkrankte akut unter heftigen Schmerzen in der Lebergegend nebst Ikterus und Bilirubinurie, aber nicht Urobilinurie; die Faeces waren acholisch. Die Schmerzen hielten an, und der Kranke wurde wegen Steinverdacht einen Monat später operiert. Bei der Operation wurde festgestellt, dass die Passage durch Choledochus und

Papilla Vateri frei war; aber die Leber war vergrössert, die Leberkante abgerundet, die Leberoberfläche kleinknollig und von grauen Streifen durchzogen. Eine am Tage vor der Operation angestellte Ci-Probe ergab 49.5 γ /ml. Eine grössere Erfahrung in bezug auf den Wert der Probe hätte dem Patienten die Operation und die auf Grund einer cholämischen Blutung entstandenen Komplikationen ersparen können.

Bei den zwei Fällen mit Leberzirrhose hat die Ci-Bestimmung pathologische Werte für Ci/s aufgewiesen.

Stenosis ductus choledochi.

Der Chirurg steht oft vor einer schwierigen Aufgabe, wenn er bei einem Ikterusfall zu den Operationsindikationen Stellung nehmen soll. Obgleich man seit Einführung des K-Vitamins in die Therapie die cholämischen Blutungen beherrschen kann, bleibt doch ein grosses Risikomoment bestehen, indem eine postoperative Leberinsuffizienz, wie kürzlich von J. P. STRÖMBECK (1941) hervorgehoben wurde, zur Ursache eines unglücklichen Ausgangs der Operation werden kann. Der Chirurg hat nach wie vor das Recht zu erwarten dass man ihm Gelegenheit gibt, die Situation binnen zwei Wochen nach dem Ikterischwerden des Kranken zu beurteilen. Eine Leberfunktionsprobe, die mit dem höchsten Grad der Wahrscheinlichkeit eine Antwort auf die Frage: Choledochusstenose oder Hepatitis? gibt, ist deshalb von allergrösstem Wert.

Die Erfahrung des Verfassers in bezug auf den Wert der Ci-Bestimmung für die Diagnose der Choledochusstenose basiert auf 27 Untersuchungen des Ci/s bei 15 Patienten. Bei 8 Patienten, Fall 38—45, beruhte die Stenose auf einem Stein im Ductus choledochus, während die Ursache der Stenose bei 7 Patienten, Fall 46—52, in einer durch Tumor bedingten Kompression oder damit vergleichbaren Umständen bestand.

Lithiasis ductus choledochi.

Bei den 8 Patienten mit Choledochusstein wurde die Ci-Bestimmung 12 mal ausgeführt. Nur ein Kranker, Fall 38, wies einen leicht erhöhten Wert von 32.1 γ /ml auf, während die Proben bei den übrigen 7 Patienten Werte unter 28 γ /ml ergaben.

Von den 8 Patienten mit Choledochussteinen wurden 5 der Operation unterzogen, und die klinische Diagnose konnte in allen

Fällen bestätigt werden. Diese Kranken waren in vielen Fällen sehr lange ikterisch gewesen, ehe sie auf die chirurgische Abteilung verlegt wurden. Der Patient Nr 39 hatte 13 Wochen, der Patient Nr 41 10 Wochen an intermittierendem Ikterus und Fieber gelitten, bevor er in chirurgische Behandlung kam. Kein einziger der Patienten wurde binnen zwei Wochen nach dem Ikterischwerden operiert. Bei 2 Kranken lagen beachtenswerte Kontraindikationen gegen eine Operation vor; sie wurden nicht operiert, während ein Patient bei Kriegsausbruch zum Abbrechen der Behandlung gezwungen war. In 3 von 5 Fällen starb der Kranke im Anschluss an die Operation (Fall 38, 41 und 42). Die Todesursache muss in allen diesen Fällen mit dem langwierigen Krankheitszustand des Patienten in Zusammenhang gesetzt werden. In Fall 38 traten eine Nahtinsuffizienz und reichlicher Gallenfluss aus der Wunde hinzu, ebenso in Fall 42, wo der Tod unter dem Bilde des Leberkomas eintrat. In Fall 41 wurde der Tod durch eine eholämische Blutung verursacht. Diese Komplikationen hätten möglicherweise vermieden werden können, wenn man die Kranken früher operiert hätte.

Choledochusstenose auf Grund einer Kompression durch Tumor oder andere vergleichbare Ursachen.

Eine Kompression des Duetus eholodochus lag bei 7 Patienten, Fall 46—52, vor. Die bei diesen 7 Patienten ausgeführten 15 Bestimmungen des Ci/s wiesen sämtlich Werte unter 28 γ /ml aus. Alle Patienten mit Ausnahme von Nr 48 waren wenigstens 4 Wochen ikterisch gewesen, als die erste Probe untersucht wurde.

Ein Pankreaskarzinom bildete die Ursache für den Ikterus des Patienten in Fall 46 und vermutlich auch in Fall 47. In Fall 46 wurde die Diagnose bei der Operation bestätigt, in Fall 47 wiederum durch die Sektion. Der Pathologe hatte in diesem Fall konstatiert: Cirrhosis (Carcinoma?) pancreatis, Choledochusstenose und biliäre Leberzirrhose. Trotz der sekundären Leberzirrhose waren die Werte bei drei Ci-Bestimmungen normal. Fall 48 erbot bei der Sektion ebenfalls Veränderungen sowohl in der Leber als im Pankreas. Der Kranke war ein junger Mann, der nach wiederholten Schmerzattacken im Bauch an einer Pankreasnekrose erkrankte. Die Probelaaparotomie ergab ausgedehnte, harte, peripankreatische Infiltrate. Bei der Sektion wurde eine totale Pankreasnekrose gefunden, bei der Mikroskopie der Leber sah man Nekrosenherde um die vv. centrales. Gelegentlich der Opera-

tion, zwei Tage vor Eintritt des Todes, hatten keine makroskopischen Leberveränderungen wahrgenommen werden können, und der Kranke war nur einige Tage ikterisch gewesen. Der Ikterus lässt sich am besten als Folge einer Kompression des Ductus choledochus durch die peripankreatischen Infiltrate erklären; von den zentralazinösen Nekrosen in der Leber kann man annehmen, dass sie in einem späten Stadium infolge der Pankreasnekrose entstanden sind; möglicherweise waren es postmortale Veränderungen. Der Fall wird deshalb als ein Fall von Choledochuskompression angeführt.

Ein Magenkarzinom bildete die Ursache der Choledochuskompression in Fall 49 und 50; die Diagnose wurde in beiden Fällen bei der Operation verifiziert. In Fall 51 war früher ein von einem ektopischen Testikel ausgehendes Seminom operiert worden; nun lagen grosse und ausgedehnte Tumormassen im Bauch vor und der Ikterus wurde als Folge einer hierdurch bedingten Kompression aufgefasst. In Fall 52 war die Diagnose Lymphogranulomatosis früher durch die Mikroskopie einer probeexzidierten Lymphdrüse bestätigt worden; dass der Ikterus in diesem Fall auf einer Kompression durch vergrösserte periportale Drüsen beruhte, ist wahrscheinlich.

In Fall 42 und 52 wurden 3 Belastungsproben ausgeführt. In Fall 42 stieg der Wert von 16.3 auf 21.9, in Fall 52 stieg er das eine Mal von 25.1 auf 31.3 und sank das andere Mal von 27.1 auf 26.1 μ /ml.

Die Galaktoseprobe wurde dreimal, in Fall 41, 45 und 52, angestellt. Alle drei Proben fielen negativ aus.

Die Adrenalinprobe wurde zweimal, in Fall 41 und 52, ausgeführt. In Fall 41 war die Probe negativ, während sie in Fall 52 einen unsichern Wert ergab (42). In diesem Fall lautete die Diagnose, wie gesagt, Lymphogranulomatosis, und der Kranke war 6 Wochen ikterisch gewesen, als die Probe ausgeführt wurde. Gleichzeitig wies eine Ci-Belastungsprobe eine leichte Steigerung des Wertes aus. Es ist offenbar, dass in diesem Fall eine leichte Parenchymschädigung vorlag; ob dieselbe auf der Gallenstase oder auf der primären Krankheit beruhte, ist unmöglich zu sagen.

Die Takata-Probe wurde 11 mal bei 6 Patienten angestellt und fiel in Fall 47, wo die Sektion eine biliäre Leberzirrhose ergab, zweimal positiv aus. Die Ci-Probe lieferte bemerkenswerter Weise normale Werte in diesem einzigen Fall des Materials, wo einer positiven Takata-Probe eine negative Ci-Probe entsprach.

Ci/s ist in den Fällen 39, 50 und 51, desgleichen in Fall 93, als unter 10 γ /ml angegeben. Als diese Bestimmungen ausgeführt wurden, kam ein Enzym zur Verwendung, das arm an sog. Spontanonatoren war; die Entfärbungszeiten bei diesen Versuchen wurden deshalb ungewöhnlich lang und die systematische Deviation machte sich stark geltend. Ob ausserdem eine Reaktionshemmung vorlag, konnte nicht ermittelt werden, aber es mutet wahrscheinlich an, dass dies der Fall war. Die Patienten hatten keine Salicylpräparate eingenommen (ALWALL 1938). Das Phänomen hat jedoch für die klinische Arbeit keine praktische Bedeutung; was man zu wissen wünscht, ist ja, ob der Wert über oder unter 28 γ /ml, der Grenze des Normalen, liegt.

Obgleich das Hindernis im Ductus choledochus bei den 15 Patienten mit Obturationsikterus in vielen Fällen nicht vollständig war, weisen doch mehrere von ihnen Zeichen einer gewissen Leberinsuffizienz auf, die sich in leichter Urobilinurie äussert. So verhielt es sich speziell in den Fällen mit Steinobturation. Wie bekannt, wird das Leberparenchym durch eine langwierige Gallenstase geschädigt. EPPINGER (1937) hebt jedoch hervor, dass die durch eine Gallenstase hervorgerufenen kleinen Nekroseherde im Leberparenchym im allgemeinen durch regenerative Prozesse dahin ausbalanciert werden, dass keine grösseren Nekroseherde entstehen. Die Entwicklung im Verlauf einer langwierigen Gallenstase verläuft jedoch in Richtung einer biliären Zirrhose, die in meinem Material bei der Operation bzw. Sektion in Fall 42 und 47 festgestellt wurde. Die so gewöhnliche Infektion der stagnierenden Galle bei der Steinobturation ruft indessen auch Veränderungen im Leberparenchym hervor. Dafür, dass diese bei Obturationsikterus entstehenden Parenchymveränderungen in der Leber den Wert der Probe für die Differentialdiagnose zwischen Obturationsikterus in Frage stellen sollte, hat mein Material keinen Beleg geliefert.

Bei den untersuchten 15 Fällen von Obturationsikterus hat die Ci-Bestimmung im Blutserum nur in einem Fall einen leicht gesteigerten Wert dargeboten.

Cholecystopathia.

In der Diagnosengruppe »Cholecystopathia« sind alle die Fälle zusammengestellt worden, bei denen sich die Krankheit hauptsächlich auf die Gallenblase lokalisierte. Diese Patienten haben

auf Grund von Schmerzen in der Gallenblasengegend, oft Fieber und in gewissen Fällen Ikterus sämtlich Krankenhausbehandlung aufgesucht. Der Ikterus ist in diesen Fällen hinsichtlich seines Auftretens leicht und flüchtig gewesen. Die Anzahl der Fälle beträgt 37; in der tabellarischen Aufstellung sind sie gemäss dem Vorkommen eines Ikterus gruppiert worden. Bei 27 Patienten, Fall 53—79, fehlte der Ikterus, bei 10 Patienten, Fall 80—89, war ein Ikterus entweder bei Gelegenheit der Untersuchung oder etwas früher im Verlauf desselben Krankheitsanfalls vorhanden. Bei diesen 37 Kranken wurden 44 Bestimmungen des Ci/s ausgeführt. Bei 32 Bestimmungen wurden Werte unter 28 γ /ml erhalten, während 12 Bestimmungen erhöhte Werte ergaben. Es ist ja nicht verwunderlich, dass ein Teil der Patienten mit Cholecystopathie gesteigerte Werte aufweist. In vielen Fällen war das Gallenleiden alten Datums, und waren dem Anfall, während dessen die Ci-Bestimmung ausgeführt wurde, viele andere vorausgegangen, und deshalb ist es berechtigt, in diesen Fällen eine Leberschädigung zu erwarten. Viele von den Patienten dieser Diagnosengruppe waren recht alt, und unter den Kommentaren zu den Fällen findet man mehrere komplizierende Krankheiten verzeichnet, die steigernd auf den Ci-Wert wirken können. Betrachten wir die Fälle, die erhöhte Werte aufwiesen, so bemerken wir, dass in 5 Fällen, Nr 61, 62, 63, 84 und 85, kardiovaskuläre Krankheitszustände vorliegen. Die Patientin Nr 71 hatte während zweier vorausgegangenen Schwangerschaften an Nephropathie gelitten. Eine tertiäre Lues kam in Fall 58 vor, während Fall 78 durch Alkoholismus und Delirium tremens kompliziert war. Patient Nr 87 war senil. In Fall 77 hatten 8 Jahre lang Gallenbeschwerden bestanden. Fall 83 wurde durch Diastasurie kompliziert. Die Erklärung für den gesteigerten Wert in Fall 76 kann darin liegen, dass die Probe während eines Schmerzanfalls entnommen wurde, was in den übrigen Fällen nicht vorkam. Komplikationen ähnlicher Art haben bei einer Anzahl anderer Fälle in dieser Diagnosengruppe vorgelegen; aber das oben Angeführte gibt einen Hinweis darauf, weshalb der Ci/s bei Patienten mit Cholecystopathie so oft gesteigert ist, selbst wenn keine komplizierende Hepatitis vorliegen sollte. Die Bestimmung des Ci-Wertes hat jedoch in diesen Fällen durchaus nicht das Interesse für den Chirurgen, wie es die Probe in Fällen mit schwererem Ikterus bei Patienten mit Hepatitis oder Choledochusstenose hat.

In Fall 53 und 54 wurde ausserdem sowohl die Galaktose- als die

Adrenalinprobe angestellt. Ebenso wie die Ci-Bestimmung fielen auch diese Proben negativ aus. Die Takata-Probe wurde bei 12 Patienten ausgeführt. Die Zahl der Proben belief sich auf 14. Sie fielen sämtlich negativ aus.

Die 9 Patienten, deren Diagnose unsicher geblieben war, findet man in der tabellarischen Aufstellung unter Nr 90—98. Eine nähere Analyse dieser Fälle wird nicht gegeben, da sie in keine der obigen Diagnosengruppen eingereiht werden konnten.

Schlussfolgerungen.

1. Bei katarrhalischer Hepatitis und akuter Leberatrophy ist die Ci-Bestimmung im Blutserum eine sehr empfindliche Probe auf eine gestörte Leberfunktion. Bei diesen Krankheitszuständen erwies sich die Ci-Probe als etwa zweimal so empfindlich wie die Galaktoseprobe und die Takata-Probe, während sich die Adrenalinprobe als ebenso empfindlich wie die Ci-Probe erwies.

2. Bei Obturationsikterus lieferte die Ci-Probe in der Regel normale Werte. Die Probe besitzt deshalb grossen Wert für die Differentialdiagnose zwischen Hepatitis und Obturationsikterus.

Material in Tabellenform.

Fall Nr	Dauer des Ikterus in Wochen	Ikterus-index nach Meulengraecht	Ci/S	Sonstige Angaben
1	2	22	31.0	<i>Hepatitis catarrhalis.</i>
	3	70	33.0	Galaktose 1.2. Adrenalin 37.
	4	65	36.6	Galaktose 1.6. Takata —.
	5	20		Galaktose 1.8. Takata —.
				Galaktose 0.8.
2	3	13	68.8	Galaktose 1.47.
			41.5	
	4		40.5	Adrenalin 9.
	5	8	31.8	
	6	8	40.8	Takata —.
	8		32.3	Takata +.
	9	3	125.7	Hatte vor der Probe Preisselbeersaft getrunken.
			28.2	Takata —.
	10	4	27.2	Takata —. Lues III, hatte 12 g Neosalv. und 4 g Bi in 7½ Monaten bekommen.

Fall Nr	Dauer des Ikterus in Wochen	Ikterus- index nach Meulen- gracht	Ci/S	Sonstige Angaben
3	3		105.0	
	4	125	90.9	Galaktose 0.
	6	72	62.8	Takata ++.
	7	45	56.1	Takata +++.
	8	50	57.4	Takata ++.
	9	39	49.8	Takata +++.
	10	36	50.7	Takata +++.
	11	27	53.2	Takata +++.
				Seit 5 Jahren per- niziöse Anämie. War 4 Mon. nach der letzten Probe noch ikterisch, geheilt.
4	3	112	44.5	Galaktose 4.2.
	4	115	55.4	Galaktose 2.8.
	6	68	49.3	Galaktose 2.45. Adrenalin 26.
	8	30	54.4	
5	1		52.6	
6	4	140	39.2	Takata +.
7	6	40	30.6	
	7		28.3	Ci-Belastung 38.5.
8	2	200	38.8	Takata —.
9	2	120	36.9	Galaktose 5.49.
	12		65.1	
	13	25	65.7	
	14	17		
10	1	95	60.0	Galaktose 6.2.
	4	40	43.9	
11	3	170	44.4	Takata —.
	4	60	29.9	Takata —.
12	5		56.3	
	6			Galaktose 1.48.
13	2		42.9	
	4		42.0	
14	2	65	41.6	Takata —.
	3	50	46.8	Takata —.
	5	20	30.3	Takata —.
15	2		50.3	Galaktose 1.54. Graviditas mens. VI.

Fall Nr	Dauer des Ikterus in Wochen	Ikterus- index nach Meulen- gracht	Ci/S	Sonstige Angaben
16	3 4 5		52.5 20.8	Takata +. Takata +. Galaktose 6.30. Alcoholismus chron.
17	4 5 7	50 20	41.7 30.0 28.1	
18	2	130	56.0	Takata +. Febriler Abort; Sulphon- amid.
19	3	70	34.0	
20	1 3 4	33 180 154	29.8 30.7 45.8	Takata —. Takata —. Takata —. Lues seit 20 Jahren. Die I Kur mit Neosalv. und Bi vor 2 Mon. abgeschlossen.
21	1 2	28 14	34.0 19.8	Galaktose 2.8. Adrenalin 20.
22	3 4 5 6	110 64 55 23	43.5 28.6 35.8 30.9	Galaktose 5.4. Adrenalin 20.
23	1 2 3 4	48 15 10	45.8 41.0 43.8	Galaktose 4.8. Adrenalin 33.
24	2 3 4 5 6 7 8 9	75 84 24 30 24 12 8	54.4 55.6 48.0 44.0 36.7 35.9 30.3	Galaktose 1.75. Adrenalin 25.
25	2 4 5		41.1 29.8 26.8	
26	2 3 4		35.8 38.2 35.2	

Fall Nr	Dauer des Ikterus in Wochen	Ikterus- index nach Meulen- gracht	Ci/S	Sonstige Angaben
27	2	70	27.2	
			23.1	Ci-Belastung 25.8.
	3	40	23.5	Ci-Belastung 25.1.
28	2	40	26.2	
	3	22	21.6	Ci-Belastung 22.6.
29	2	35	27.9	Takata —.
				<i>Hepatitis catarrhalis, exitus letalis.</i>
30	7	180	65.4	Galaktose 1.6. Takata +++.
	8	130	55.8	Takata +++.
	9	110	51.8	Takata ++. Nach 3 Wochen ge- storben.
31	7		50.7	Takata —.
	8	170	55.6	Takata +. Gestorben.
32	2	50	60.8	Nach 3 Wochen gestorben.
				<i>Atrophia hepatis acuta (gestorbene Patienten).</i>
33	2	22	50.5	Galaktose 16.85. Adrenalin 9. Sek- tion: Atrophia rubra hepatis etc.
34	5	160	33.1	Ci-Belastung 52.5. Trotylvergiftung. Sektion: Necrosis et atrophia he- patis etc.
35	8	220	34.3	Sektion: Atrophia hepatis acuta flava etc.
				<i>Cirrhosis hepatis.</i>
36	3	15	48.2	Galaktose 2.24.
	4	12	39.3	Galaktose 0. Takata ++.
	5		44.3	Takata +.
	6	13	46.5	Takata ++.
	7	12	51.3	Takata +++.
				Sektion: Cirrhosis hepatis typus Laennec.
37	4			Takata +.
	5		49.5	Laparotomia explorativa, duodeno- tomia et choledochotomia explora- tiva.
	11		34.9	

Fall Nr	Dauer des Ikterus in Wochen	Ikterus- index nach Meulen- gracht	Ci/S	Sonstige Angaben
38	1 5	6 28	32.1	<i>Stenosis ductus choledochi.</i> Diagnose bei der Operation: Status post cholecystectomiam. Lithiasis ductus choledochi. — Gestorben.
39	8 10 11 13	25 11 7 7	<10.0 <10.0 <10.0 <10.0	Diagnose bei der Operation: Chole- cystitis. Lithiasis ductus chole- dochi.
40	3		25.1	Diagnose bei der Operation: Chole- cystitis et cholelithiasis. Lithiasis ductus choledochi et ductus hepatici.
41	9 10	144	22.9 18.1	Galaktose 1.7. Adrenalin 60. Diag- nose bei der Operation: Chole- cystitis. Lithiasis ductus chole- dochi. — Gestorben. Sektion: Lithiasis ductus hepatici dx etc.
42	9	24	16.3	Ci-Belastung 21.9. Diagnose bei der Operation: Status post chole- cystitidem. Lithiasis ductus chole- dochi. Cirrhosis biliaris hepatis. Gestorben.
43	34	44	22.4	Klinische Diagnose: Lithiasis ductus choledochi. Später an derselben Krankheit gestorben.
44	4		24.9	Klinische Diagnose: Lithiasis ductus choledochi. Coronarinsuffizienz und Hypertonie.
45	32 34	13 16	17.6	Galaktose 0. Klinische Diagnose: Lithiasis ductus choledochi. Myo- degeneratio cordis.
46	10		22.2	Diagnose bei der Operation: Carci- noma pancreatis. Stenosis ductus choledochi.
47	8 9 10		23.5 19.2 22.0	Sektion: Cirrhosis (carcinoma?) pan- creatis. Stenosis ductus chole- dochi. Stasis biliaris. Cirrhosis biliaris hepatis etc.

Fall Nr	Dauer des Ikterus in Wochen	Ikterus-index nach Meulengracht	Ci/S	Sonstige Angaben
48	1	25	12.9	Diagnose bei der Operation: Necrosis pancreatis. Infiltratum peripanicum. Gestorben. Sektion: Necrosis totalis pancreatis. Mikroskopie: Beginnender Zerfall der Leberzellen um die vv. centrales.
49	4		23.5	Diagnose bei der Operation: Carcinoma ventriculi. Stenosis ductus choledochi. Später gestorben.
50	6	45	<10.0	Sektion: Carcinoma ventriculi cum metastat. lymphoglandular. portae hepatis etc. Compressio ductus choledochi. Carcinoma primar. lobi sin. hepatis?
	7	48	<10.0	
51	10	200	<10.0	Mikroskopie nach früherer Operation: Seminoma. Klinische Diagnose: Tumor malignum permagn. abdominis.
	11	44	<10.0	
52	6	80	21.3	Adrenalin 42. Galaktose 1.6.
			23.3	
	7	112	23.1	Ci-Belastung 31.3.
			25.8	
	8	66	27.1	Ci-Belastung 26.1. Probeexzision und Mikroskopie: Lymphogranulomatosis. Später an derselben Krankheit gestorben.
53		5	25.2	<i>Cholecystopathia.</i> Galaktose 0. Adrenalin 56. Takata —. Röntgen: Verzögerte Füllung und Entleerung der Gallenblase.
54		6	21.9	Galaktose 0. Adrenalin 54. Hypertrophia prostatae. Retentio urinae.
55		3	18.8	Takata —. Cholecystectomy: Entzündliche Veränderungen, grosser Solitärstein in der Gallenblase.
56		10	15.5	
57		10	26.5	Takata —.

Fall Nr	Dauer des Ikterus in Wochen	Ikterus- index nach Meulen- gracht	Ci/S	Sonstige Angaben
58		4 $\frac{1}{2}$	29.2	Takata —. Lues III.
59		5 $\frac{1}{2}$	23.8	Takata —. Röntgen: Gallenblase füllt sich schlecht, undeutlicher Steinschatten.
60			27.0	Takata —.
61			43.5	Obesitas. Myodegeneratio cordis.
62			34.0 19.4	Myodegeneratio cordis.
63			29.8	Vor 3 Mon. neg. Röntgenbefund bei der Cholecystographie. Myodege- neratio cordis.
64			22.1	Insufficiencia cordis. Hypertonie (240). Röntgen: Multiple Steine in der Gallenblase.
65		5	27.4	Röntgen: Gallenblase füllt sich nicht. Vitium cordis.
66		3	12.4 13.1	Takata —. Takata —. Leichte Albuminurie. Carcinoma grad. III colli uteri.
67		11	20.5 26.9	Takata —. Takata —.
68		6	18.2	Takata —.
69		7	12.4	Takata —. Cholecystectomy: Ent- zündl. Veränderungen, multiple Steine in der Gallenblase.
70			25.0	Takata —. Röntgen: Gallenblase füllt sich nicht.
71		4	34.3	Nephropathie bei 2 Graviditäten. Röntgen: Gallenblase füllt sich nicht, runder Steinschatten.
72		7	19.3	Röntgen: Gallenblase entleert sich langsam.
73		3	21.9	Myodegeneratio cordis.
74		2	17.0	Gallenblase palpabel, gänseeigross. Paratyphus.

Fall Nr	Dauer des Ikterus in Wochen	Ikterus- index nach Meulen- gracht	Ci/S	Sonstige Angaben
75		4	23.0	
76			34.0	
77		5	35.0	Cholecystectomy: Ca 100 Steine in der Gallenblase.
78		5	29.4	Delirium tremens.
79		4	16.0	
80	2	15	25.8	Myodegeneratio cordis. Hypertonie (170).
81	1	20	21.2	Myodegeneratio cordis. Hypertonie (185).
82	8		23.2	Diastasurie, Wohlgemuth ad 512. Hypertonie (170).
83	5 6	23	27.0 38.0	Diastasurie, Wohlgemuth ad 512. Röntgen: Gallenblase füllt sich nicht.
84	2	16	28.6 19.5	Myodegeneratio cordis. Röntgen: Gallenblase füllt sich nicht.
85	1 2 3	40 11 11	25.4 32.4 27.2	Takata —. Röntgen: Stein Schatten in der Gallenblase. Hypertonie (190). Leichte Albuminurie.
86	2	5	17.1	Ikterus vor 1 Woche. Röntgen vor 3 Mon.: Gallenblase füllt sich nicht. Konkrement Schatten in der Gallenblase.
87	1		39.6	Senil. Röntgen: Gallenblase füllt sich nicht.
88	1	9	18.2	Ikterus schon im Abnehmen. Cholecystectomy: Unbedeutende entzündliche Veränderungen, kein Stein.
89	2		25.0	Cholecystendysis: Gallenblase geschrumpft, Eiter und Konkreme im Fundus, Ductus chole- dochus frei.

Fall Nr	Dauer des Ikterus in Wochen	Ikterus-index nach Meulengracht	Ci/S	Sonstige Angaben
90	2		32.8	<i>Diagnosis incerta.</i> Takata —.
	3	80	52.8	Takata —. Galaktose 1.57.
	4	90	59.6	Takata —. Galaktose 1.12. Klinische Diagnose: Carcinoma pancreatis cum metastat. hepatis?
91	4		33.7	Klinische Diagnose: Icterus simplex? Myodegeneratio cordis.
92	6			Takata +. Galaktose 0.96.
	7		31.1	
	9		31.3	Ci-Belastung 36.6. Klinische Diagnose: Carcinoma pancreatis? Icterus.
93	14	12	<10.0	Takata —.
	23			Takata —. Klinische Diagnose: Cholecystopathia. Cirrhosis hepatis?
94	2	60	34.2	Galaktose 2.73. Adrenalin 39. Klinische Diagnose: Hepatitis acuta?
	3	60	32.7	(Cholelithiasis? Carcinoma pancreatis?)
95	4		35.9	Klinische Diagnose: Cholangitis.
	5		30.2	Pyelitis (coli). Bronchitis asthmatica.
	6		30.1	Myodegeneratio cordis.
	7		24.1	
96	2	5	16.6	Klinische Diagnose: Hepatitis et pancreatitis acuta. Status post cholecystectomiam.
97			28.9	
			26.4	
			26.1	Ci-Belastung: 28.1. Intermittierender leichter Ikterus 14 Jahre lang. Klinische Diagnose: Hepatitis. Sclerosis multiplex?
98	1	12	34.0	Klinische Diagnose: Cholelithiasis. In der Diagnosengruppe »Diagnosis incerta« ist die klinische Diagnose unverändert verzeichnet worden.

Zusammenfassung.

Die THUNBERG-Methode zur Bestimmung der Citronensäure (Ci) hat in der Hand des Verfassers eine Differenz von im Mittel 3.78 % des Mittelwertes für zwei Bestimmungen an derselben Serumprobe ergeben. — Die sog. systematische Deviation der Serumkurve ist schuld daran, dass der Wert für den Citronensäuregehalt im Blutserum (Ci/s), der aus den Röhrchen mit 0.3, 0.4 und 0.5 ml Serumverdünnung berechnet wird, um etwa 7.5 % zu gross wird. Wenn die systematische Deviation durch eine indifferente Eiweisslösung verursacht wird, wird die Ausbeute einer bekannten Menge Ci bei der Berechnung aus den Röhrchen mit 0.3, 0.4 und 0.5 ml nur um 1.8 % zu gross.

20 gesunde Personen hatten Ci-Werte zwischen 19.5 und 28.8 γ /ml bei einem Mittel von 24.35 γ /ml. Als obere Grenze für die normalen Werte sind 28 γ /ml angesetzt worden.

Verf. untersuchte 81 Proben von 29 Fällen mit katarrhalischer Hepatitis, die in Heilung ausgingen. In 3 Fällen von sehr leichter Hepatitis waren alle (6) Proben normal, in den übrigen 26 Fällen waren 4 Proben während der Rekonvaleszenz normal, während alle übrigen (71) Proben erhöhte Werte darboten. Drei Patienten, die an Hepatitis starben, und drei, bei denen die Sektion eine akute Leberatrophie ergab, hatten in allen Proben erhöhte Ci-Werte.

In den Fällen, wo die Galaktose-, Adrenalin- oder die Takata-Probe parallel mit der Ci-Probe ausgeführt wurden, zeigte es sich, dass die Ci-Probe doppelt so empfindlich wie die Galaktoseprobe und die Takata-Probe war, während sich die Adrenalinprobe als ebenso empfindlich wie die Ci-Bestimmung erwies. Die Schlussfolgerung gründet sich auf das Ergebnis von 17 Galaktose-, 8 Adrenalin- und 30 Takata-Proben, die bei 22 Patienten mit der Ci-Probe verglichen wurden. Zwei Fälle von Cirrhosis hepatis boten erhöhte Werte dar.

Eine Stenose des Ductus choledochus lag in 15 Fällen vor. Hierbei handelte es sich in 8 Fällen um eine Steinobturation und in 7 Fällen um Kompression durch Tumor oder ähnliche Ursachen. Von diesen Patienten wurden 27 Proben untersucht. Lediglich ein Patient mit Steinobturation wies einen leicht gesteigerten

Ci-Wert auf; die übrigen hatten Werte unter 28 γ /ml. Die durch die Gallenstase möglicherweise verursachte Schädigung des Leberparenchyms gab in diesen Fällen keine Veranlassung zu einer Steigerung des Ci-Wertes. In einigen Fällen wurden die Galaktose-, die Adrenalin- und die Takata-Probe angestellt. Eine Adrenalinprobe ergab einen unsicheren Wert und eine Takata-Probe fiel positiv aus (biliäre Zirrhose); die übrigen Proben waren negativ.

Die Patienten mit Cholecystopathie wiesen in vielen Fällen gesteigerte Ci-Werte auf. Von 44 bei 37 Patienten angestellten Proben waren 32 normal; 12 ergaben erhöhte Werte, von denen man in vielen Fällen annehmen konnte, dass sie auf komplizierenden Gefäss-, Herz-, Nieren- usw. Krankheiten oder auf einer leichten sekundären Hepatitis beruhten.

Die Bestimmung des Citronensäuregehaltes im Blutserum ist eine empfindliche Probe auf eine gestörte Leberfunktion und hierdurch von grossem Wert für die Differentialdiagnose zwischen Hepatitis und Obturationsikterus.

Summary.

In the author's hands, the THUNBERG method for the determination of citric acid gave average difference of 3.78 percent of the mean value for two determinations made on the same specimen of serum. The so-called systematic deviation of the serum curve is the reason why the value for the citric acid content of the blood serum calculated on tubes with 0.3, 0.4 and 0.5 Ml. serum dilution is about 7.5 percent too high. Since the systematic deviation is caused by an indifferent protein solution, the result with a known quantity of citric acid calculated on tubes with 0.3, 0.4 and 0.5 Ml. will be only 1.8 percent too high.

Twenty healthy persons had citric acid values between 19.5 and 28.8 γ /Ml., the average being 24.35 γ /Ml. The maximum for normal values was set at 28 γ /Ml.

The author examined 81 samples from 29 cases of catarrhal hepatitis in which the patients recovered. In three cases of mild hepatitis, all the tests (six) gave normal results, in the remaining

26 cases four tests made during convalescence were normal, and the other 71 tests showed increased values. Three patients who died of hepatitis and three in which autopsy revealed acute hepatic atrophy had increased citric acid values in all the tests.

In the cases in which galactose, adrenalin or TAKATA tests were conducted concurrently with the citric acid test, the latter was found to be twice as sensitive as the galactose and TAKATA tests, while the adrenalin test showed the same sensitivity as the citric acid test. This comparison was based on the results of 17 galactose, 8 tests on 22 patients. Two cases of cirrhosis showed increased values.

Stenosis of the common bile duct was present in 15 cases, due in eight of them to obstruction by a calculus and in seven to compression by a tumor or some other comparable process. Twenty-seven tests were conducted on these patients. Only one of the patients with obstruction due to a stone showed a slightly increased citric acid value, the remainder having less than 28 γ /Ml. Any damage to the parenchyma of the liver caused by the biliary stasis did not give rise to an increase in the citric acid level. Galactose, adrenalin and TAKATA tests were made in some of the cases. In one of the adrenalin tests the result was uncertain and in one of the TAKATA tests the result was positive (biliary cirrhosis); the results of the remaining tests were all negative.

Many of the patients with diseases of the gallbladder exhibited increased citric acid values. Of 44 tests on 37 patients, 32 gave normal results and twelve showed increased values, which in many cases may have been due to complicating vascular, cardiac, renal or other diseases, or to a mild secondary hepatitis.

The determination of the citric acid content of the blood serum is a sensitive test of disorder of the hepatic function and thus of great value in differentiating between hepatitis and obstructive jaundice.

Résumé.

La méthode indiquée par THUNBERG pour le dosage de l'acide citrique (Ci) a donné, entre les mains de l'auteur, une différence moyenne de 3,78 % d'avec le chiffre moyen trouvé par deux dosages pratiqués sur le même échantillon de sérum. — Ce qu'on appelle la déviation systématique de la courbe sérique a pour conséquence que le chiffre de la teneur en acide citrique du sérum sanguin (Ci/s), qu'on détermine sur des tubes avec des dilutions du sérum de 0.3, 0.4 et 0.5 ml, est exagéré d'environ 7.5 %. — Lorsque la déviation systématique est causée par une solution indifférente d'albumine, la récupération d'une quantité connue de Ci, pratiquée sur des tubes avec 0.3, 0.4 et 0.5 ml., donne des chiffres qui ne sont exagérés que de 1.8 %.

20 sujets bien portants avaient des chiffres de Ci entre 19.5 et 28.8 γ /ml, le chiffre moyen étant de 24.35 γ /ml. On a considéré 28 γ /ml comme la limite supérieure des chiffres normaux.

L'auteur a examiné 81 prélèvements provenant de 29 cas d'hépatite catarrhale qui guérissent. Dans 3 cas d'hépatite très légère toutes les épreuves (6) étaient normales, dans les 26 cas restants, trois étaient normales pendant la convalescence, toutes les autres (71) présentant des chiffres trop élevés. Trois malades qui moururent d'hépatite, et 3 autres où l'autopsie révéla une atrophie aiguë du foie, avaient des chiffres augmentés de Ci dans toutes les épreuves.

Dans les cas où l'on fit les épreuves de la galactose, de l'adrénaline et de Takata parallèlement à celle du Ci, cette dernière se montra deux fois plus sensible que les épreuves de la galactose et de Takata, tandis que celle de l'adrénaline se révéla aussi sensible que le titrage du Ci. Les conclusions se basent sur les résultats de 17 épreuves de la galactose, 8 de l'adrénaline et 30 de Takata qui furent, chez 22 malades, comparées à celles du Ci. — 2 cas de cirrhose du foie présentaient des chiffres augmentés.

Il existait 15 fois une sténose du cholédoque qui était dans 8 cas due à une obstruction calculeuse et dans 7 à une compression par une tumeur ou d'autres causes comparables. Chez ces malades on fit 27 épreuves. Un seul sujet avec obstruction par calcul présenta une légère augmentation du Ci, les autres avaient des chiffres au-dessous de 28 γ /ml. Le dommage éventuellement causé au

parenchyme hépatique par la stase biliaire n'a pas occasionné dans ces cas-là d'élévation de la quantité de Ci. Dans quelques cas on fit les épreuves de la galactose, de l'adrénaline et celle de Takata. Une épreuve de l'adrénaline donna un résultat douteux et une épreuve de Takata fut positive (cirrhose biliaire), les autres restèrent négatives.

Les malades atteints de cholécystopathie présentèrent dans beaucoup de cas une augmentation du chiffre du Ci. Sur 44 épreuves concernant 37 malades 32 étaient normales et 12 montraient une augmentation, laquelle dans beaucoup de ces cas pourrait être attribuée à des affections surajoutées des vaisseaux, du cœur, des reins, etc., ou à une légère hépatite secondaire.

Le titrage de l'acide citrique du sérum sanguin est une épreuve sensible pour préciser un trouble de la fonction hépatique, et par là elle possède une grande valeur pour le diagnostic différentiel entre hépatite et ictère par obstruction.

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Aus der chirurgischen Abteilung des Maria-Krankenhauses
zu Helsinki.
(Vorstand: Prof. HENRI BARDY.)

Über die chirurgische Behandlung des Pylorospasmus.¹

Von
ANJA BARDY.

Die Therapie des Pylorospasmus ist heute in Finnland eine konservative. Die Kinderärzte wenden sich bei der Behandlung des Leidens nur äusserst selten an einen Chirurgen, einige von ihnen niemals. Im Laufe der letzten zwei Jahre haben die Kinderärzte jedoch mehrere Fälle zur Operation auf die chirurgische Abteilung des Maria-Krankenhauses geschickt, die wieder erweisen, dass auch die Chirurgie bei der Behandlung dieser Krankheit ihre Bedeutung besitzt.

Nachdem das pathologisch-anatomische Krankheitsbild des Pylorospasmus, ein im Pylorus lokalisierter, fingerdicker, knorpelartiger Muskelring bekannt geworden war, hat man begonnen, bei seiner Behandlung chirurgische Eingriffe zur Anwendung zu bringen. Schon in der zweiten Hälfte des 19. Jahrhunderts wurden Gastro-enterostomien und Pyloroplastiken ausgeführt; aber die Ergebnisse waren schlecht, weil die nur einige Wochen alten Kinder keine so grossen Eingriffe ertrugen. Im Jahre 1910 publizierte WEBER ein neues Verfahren, wozu er die Idee von MIKULICZ' Pyloroplastik erhalten hatte: er spaltete den Pylorusring in der Längsrichtung bis auf die Schleimhaut und vernähte ihn in der Querrichtung. Schon vor ihm hatte der Franzose FREDET eine ähnliche Operation ausgeführt, diese aber so mangelhaft publiziert, dass sie nicht weiter bekannt wurde. Danach führte RAMSTEDT Operationen nach der Weberschen Technik aus. Hierbei war es in einem Falle zufällig technisch unmöglich, den Pylor-

¹ Vortrag, gehalten auf der Versammlung des Finnischen Chirurgenvereins am 19. XI. 43.

russchnitt quer zu vernähen, so dass er offen bleiben musste. Der Fall heilte unerwartet gut, weshalb RAMSTEDT andere Operationen in gleicher Weise ausführte und i. J. 1911 diese den Namen WEBER-RAMSTEDT (im französischen Schrifttum FREDET) tragende extramuköse Anthro-pylorotomie veröffentlichte, die verdientermassen die einzige bei der chirurgischen Behandlung des Pylorospasmus gebrauchte Methode geworden ist.

Beim Ausführen der Operation sind folgende Umstände zu berücksichtigen:

1) Vor der Operation wird subkutan eine Kochsalz-Trauben-zuckerlösung verabreicht.

2) *Das Kind ist sorgfältig vor Kälte zu schützen.* Es wird in Watte gewickelt, so dass nur der Kopf und das Operationsfeld entblösst bleiben, und mit einer Binde auf einem Kissen fixiert, auf dem man bei Bedarf ausserdem ein Thermophor anbringen kann.

3) Als Anästhesie verwendet man am bequemsten die Äther-Tropfnarkose, die die ganze Zeit über ganz oberflächlich sein kann. Gewöhnlich reichen ca 10—15 g Äther. Wenn man die Beine des Kindes von einer Pflegerin festhalten lässt, wird der Verlauf der Operation durch sein geringes Spannen nicht gestört. Manche Chirurgen (HABERER) bedienen sich der Lokalanästhesie, aber deren Ausführung verlängert die Behandlungszeit, wogegen das Kind empfindlich ist. SPAMER wiederum operiert ohne jede Betäubung.

4) *Der Operationsschnitt wird in der Längsrichtung transrektal, rechts von der Mittellinie möglichst oben gesetzt,* wobei er fast vollständig in das Lebergebiet fällt. Dies verringert die Herniengefahr. Der Amerikaner ROBERTSON empfiehlt einen kurzen Rippenbogenschnitt, SINGLETON einen transrektalen, wobei die hintere Rektusscheide quer eröffnet wird, aber der ersterwähnte Schnitt ist am einfachsten und am wenigsten zeitraubend.

5) Wenn das Kind hiernach presst, wölbt sich der luftballon-artige Magen aus der Wunde hervor und man bekommt den Pylorus leicht zu fassen. Vor einem Heraussuchen des Magens aus der Bauchhöhle mit dem Finger ist zu warnen. Man ergreift den dicken Pylorus mit dem Daumen und Zeigefinger der linken Hand und spaltet ihn vorn in der Mitte in der Längsrichtung, bis die Schleimhaut sich vorwölbt. *Dies ist der wichtigste und schwierigste Punkt der Operation. Dicht unterhalb des Pylorus erweitert sich das Duodenum plötzlich und seine Schleimhaut bildet eine Falte nach*

dem Pylorus hin, die bei unvorsichtigem Operieren leicht lüdiert wird. Deswegen muss man mit dem Spalten des Pylorusringes vom Ventrikel her beginnen, wo es behutsam mit einem kleinen Messer vorgenommen wird, bis die helle Schleimhaut sich einstellt. Hierauf ist es leicht, den Schnitt längs der Schleimhaut mit einer kleinen stumpfen Schere und einer Hohlsonde weiterzuführen, indem man vorsichtig bis ans Duodenum präpariert. Gleichzeitig wird die Muskelschicht an den Rändern in 2 mm Breite stumpf von der Schleimhaut abgelöst, damit die Gefahr eines zu zeitigen Schliessens der Wunde vermieden wird. Auf die Duodenumseite soll man nicht gehen. Sollte die Schleimhaut trotz aller Vorsicht perforiert werden, so muss man auf das Loch eine die Serosa und Muscularis durchgreifende Naht setzen an der ein freies Netzstück fixiert wird. Dann braucht diese Komplikation die Prognose des Falles gar nicht zu verschlechtern, wie ein Fall in dem von mir eingesammelten Material beweist. Als zweite Gefahr gilt eine Blutung aus der Magenwand. In den 8 Fällen, bei denen die Verfasserin assistiert oder operiert hat, ist so gut wie keine Blutung vorgekommen, so dass ich diese Gefahr nicht für gross halten möchte. Im allgemeinen steht die Blutung leicht, wenn man einen Augenblick komprimiert oder im schlimmsten Falle ein kleine Naht legt.

6) Die Bauchdecken werden in zwei Schichten mit Katgut und die Haut mit Seidennähten vernäht, die erst nach Verlauf von zwei Wochen entfernt werden. Als Stütze für die Wunde wird noch eine Elastoplastbinde um den Rumpf gelegt.

Die Operation dauert gewöhnlich nur 10—15 Min., was besonders wichtig ist. Soweit möglich, wird das Kind unmittelbar zur Behandlung auf die Kinderabteilung verlegt, wo es schon nach Verlauf von zwei Stunden Nahrung bekommen kann. Nach einer gelungenen Operation hört das Erbrechen auf, das Gewicht beginnt rasch zu steigen, und die Behandlungszeit gestaltet sich kurz.

Das in der chirurgischen Abteilung des Maria-Krankenhauses von mir eingesammelte Material aus den Jahren 1932—1943 umfasst 20 Fälle, deren Beschaffenheit und Verlauf aus der anliegenden Tabelle erhellen.¹ Aus der Tabelle geht ferner hervor, dass es sich um viele verschiedene Operateure gehandelt hat, was danach angetan ist, die Statistik zu verschlechtern. Von diesen

¹ Nachdem ich diesen Vortrag gehalten habe, habe ich noch drei Fälle mit glücklichem Erfolg operiert. Siehe die Tabelle.

Fall Nr	Jahr	Geburts- gewicht	Alter bei Beginn der Symptome	Krankenhaus- behandlung vor der Op.	Operations- alter	Opera- tions- gewicht	Operateur
1	1932	3.250 g	4 Wochen	5 Wochen	10 Wochen	3.300 g	H. Bardy
2	1933	3.350 »	3 »	4 Tage	4 »	2.990 »	»
3	»	3.490 »	5 »	1½ Wochen	7 »	3.510 »	»
4	»	3.960 »	3 »	5 »	6 »	3.595 »	»
5	1934	?	?	?	5 »	?	»
6	1936	2.600 »	2¼ Wochen	5 Tage	4 »	2.620 »	Orkomies
7	»	4.100 »	2½ »	5 »	4 »	3.600 »	H. Bardy
8	»	3.150 »	2½ »	3 »	4 »	3.180 »	Orkomies
9	»	3.050 »	4 »	1 Woche	5½ »	3.230 »	H. Bardy
10	1937	3.650 »	2 »	2 Wochen	5 »	3.265 »	Assistenz- arzt
11	1942	4.260 »	4 »	2 »	7 »	3.610 »	H. Bardy
12	»	3.950 »	3 »	1 »	6 »	3.980 »	»
13	»	3.850 »	3 »	5 »	9 »	3.230 »	Assistenz- arzt
14	»	3.300 »	2½ »	5 Tage	5 »	3.020 »	H. Bardy
15	1943	3.350 »	2½ »	6 »	5 »	3.050 »	»
16	»	3.080 »	2 »	4 »	4 »	2.690 »	»
17	»	3.700 »	4 »	2½ Wochen	7 »	3.500 »	Pelkonen
18	»	3.400 »	2½ »	6 Tage	5 »	3.160 »	Anja Bardy
19	»	3.785 »	3 »	3 »	5 »	3.380 »	»
20	»	3.380 »	2 »	3 »	3½ »	3.340 »	»
		Nachtrag:					
21	»	3.500 g	3 »	5 »	4 »	3.660 »	»
22	»	4.230 »	3 »	7 Wochen	10 »	3.320 »	»
23	»	3.680 »	5 »	4 Tage	6 »	3.820 »	»

Fällen sind 15 geheilt, und in allen ist die Genesung nach der Operation gut fortgeschritten. Acht derselben habe ich nachuntersuchen können, 4 dagegen sind erst im Laufe der letzten Monate operiert worden, so dass die Observationszeit noch zu kurz ist: aber vorläufig geht es diesen Kindern gut. Bei den Nachuntersuchungen wurde festgestellt, dass die Entwicklung der Kinder normal gewesen war, sowie dass ihr gegenwärtiger Allgemeinzustand und Ernährungszustand gut waren. Nur bei einem lagen anamnestisch unbedeutende Leibschmerzen vor und wurde bei der Röntgenuntersuchung (SALLINEN) eine leichte Stenosis

helle.

Operat.- komplikat.	Krankheits- verl.	Ergebnis	Nachuntersuchung Okt. 1943		
			Allgemein- zust.	Abdomen	Narbe
—	Gut	Geheilt		Pat. nicht gefunden	
—	Ruptura vulneris	Gestorben			
—	Gut	Geheilt	Gut	Symptomfrei Rtg: —	Fest
Perforatio mucosae duod.	Gut	Geheilt	Gut	Geringe Beschw. Rtg: Sten. pylori	Fest
—	Fieber, Erbrech.	Gest. Obd.: Absc. subphr.			
—	Gut	Geheilt			
—	„	„	Gut	Pat. nicht gefunden Symptomfrei Rtg: —	Fest
—	„	„			
—	„	„	Gut	Pat. nicht gefunden Symptomfrei Rtg: —	Fest
Perforatio mucosae duod.	Peritonitis.	Gestorben			
—	Gut	Geheilt	Gut	Symptomfrei	Kleiner Bruch
—	„	„	„	„	Fest
Perforatio mucosae duod.	Sehr schwach	Am folg. Tage gest.			
—	Gut	Geheilt	Gut	Symptomfrei	Fest
—	Broncho- pneum.	Gestorben			
—	Gut	Geheilt	Gut	Symptomfrei	Fest
—	„	„	„	„	„
—	„	„	„	„	„
—	„	„	„	„	„
—	„	„	„	„	„
—	„	„			
—	„	„			
—	„	„			

pylori konstatiert. Den von SALMI i J. 1941 publizierten Untersuchungen zufolge, die 13 operierte und 45 konservativ behandelte Patienten umfassen, weisen die operierten später am Magen weniger Veränderungen auf als die unoperierten: die ersteren in 46 %, die letzteren in 62 %. Gelegentlich der Nachuntersuchung konnte ich ferner feststellen, dass die Operationswunden gut verheilt waren: nur bei einem Kinde lag im unteren Wundabschnitt eine kleinfingerbeerengrosse Bruchpforte vor.

Fünf Fälle, also 25 %, ¹ sind mit Tode abgegangen. Beim Stu-

¹ Die drei letzten Fälle mitgenommen 21.6 %.

dieren der ausländischen Literatur bemerkt man, dass die Sterblichkeit im allgemeinen zwischen 3.6 % (Düsseldorfer Klinik i. J. 1928, 110 Fälle) und 28 % (Boehnke 50 Fälle) schwankt. Die grosse Verschiedenheit der Zahlen ist leicht erklärlich: in den Statistiken, wo die Sterblichkeit gering ist, sind sämtliche Fälle operiert worden, in den anderen nur die schwersten. Nach den Untersuchungen Salmis (132 Fälle aus den Jahren 1915—1937) hat sich die Sterblichkeit in Finnland bei konservativer Behandlung auf 10.6 % belaufen; die Todesursachen bilden während der Behandlung erworbene Infektionen. Diese Zahl ist nicht direkt mit meinem Material vergleichbar, weil es sich hierin durchweg um mittelschwere oder schwere Fälle gehandelt hat, bei denen zuerst eine konservative Behandlung versucht wurde und die Kinder erst dann, wenn der Fall hoffnungslos erschien, zur Operation geschickt wurden. Die Todesursachen waren folgende: ein Kind ist 11 Tage nach der Operation an einer auf der Abteilung herrschenden Lungeninfektion gestorben, obgleich es sich schon gut von seiner Operation erholt und sein Gewicht zu steigen begonnen hatte. Die Obduktion bestätigte überdies, dass das Operationsgebiet gut verheilt war. Ein Kind befand sich, als es zur Operation gebracht wurde, in sehr schlechtem Zustand, weil die konservative Behandlung zu lange (5 Wochen) fortgesetzt worden war, und starb am Tage nach der Operation. Der Fall hätte nicht operiert werden und die Operationsstatistik unnötig belasten sollen, denn es war offenbar, dass das Kind keine Aussichten hatte durchzukommen. Von drei Patienten kann man annehmen, dass sie direkt an den Folgen der Operation gestorben sind: zwei an Peritonitis von denen bei einem die Schleimhaut perforiert und nicht ordentlich vernäht worden war, und bei dem andern die Operationswunde 7 Tage nach der Operation aufbrach; in dem dritten Falle wurde bei der Obduktion ein Abscessus subphrenicus festgestellt.

Wie wären denn also die Pylorospasmus-Krankheit am besten zu behandeln? In einigen ausländischen Statistiken ist man beim Operieren sämtlicher Fälle zu so niedrigen Mortalitätsziffern wie 0.56 % (LADD) und 2.2 % (NÖLL, 45 Fälle) gelangt, was für die ausschliesslich operative Behandlung spricht. Derartige Statistiken stellen jedoch Ausnahmen dar. Auf Grund meines eigenen Materials komme ich zu folgenden Schlussfolgerungen: *In allen Fällen wäre zuerst eine konservative Behandlung zu versuchen, aber die schweren Fälle unter ihnen, in denen die obenerwähnte Behandlung*

nicht zu Resultaten zu führen scheint, sollten beizeiten für die Operation abgetrennt werden. Die Entscheidung dieses Umstands ist natürlich schwierig und verlangt Erfahrung und Urteilsvermögen von dem Kinderarzt. Man hat Prozentzahlen von der Gewichtsabnahme angeführt, bei denen eine operative Behandlung indiziert ist, aber sie können irreführend sein. Auch eine Röntgendurchleuchtung hat man empfohlen und geltend gemacht, dass eine Operation motiviert ist, wenn nach Verlauf von 6 Stunden noch Kontrastmittel im Magen gefunden wird. Aber eine derartige Untersuchung strengt das auch sonst schon schwache Kind kurz vor der Operation an, so dass sie — ausser bei unklarer Diagnose — nicht zu empfehlen ist. Am wichtigsten ist die Beobachtung des Allgemeinzustandes bei dem Kinde, denn ein zu sehr heruntergekommener Patient sollte nicht mehr operiert werden. Im allgemeinen erachtet man, dass es für die Operation spricht, wenn das Gewicht trotz einwöchlicher konservativer Behandlung nicht zu steigen anfängt, insbesondere in den Fällen, wo die Symptome in den frühen Lebenswochen eingesetzt haben, und die gewöhnlich von schwererer Beschaffenheit sind als die später erkrankten. Selbstverständlich ist auch der Umstand zu berücksichtigen, wie lange nach Beginn der Symptome der Kranke in Behandlung gekommen ist. Kontraindikationen gegen die Operation sind ein zu schlechter Allgemeinzustand und alle Infektionen.

Die erfolgreiche Behandlung der Fälle setzt eine enge Zusammenarbeit zwischen Kinderarzt und Chirurgen voraus, welcher letzterer natürlich genau mit der Operationstechnik vertraut sein muss. Wünschenswert wäre es, wenn auch das Personal im Operationsaal sich über die von der Operation verlangten Aufgaben im Klaren wäre, weil Kleinigkeiten in diesen Fällen von ausschlaggebender Bedeutung sind. Auf diese Weise könnten wir unsere jetzigen Ergebnisse sicher verbessern. Ich will nicht leugnen, dass eine gute konservative Behandlung nicht auch schwere Fälle heilen könnte; aber hierzu ist eine lange Behandlungszeit notwendig, in deren Verlauf die Widerstandsfähigkeit des Kindes infolge seines schlechten Ernährungszustandes und des Gebrauchs von narkotischen Arzneien vermindert und das Kind andererseits die ganze Zeit über Infektionen ausgesetzt ist, wie sie auf Kinderstationen stets vorkommen. Eine rechtzeitig und in richtiger Weise ausgeführte Operationsbehandlung dagegen führt auch in diesen Fällen zu rascher Heilung und lässt das Kind binnen kurzem in seine natürliche Umgebung, nach Hause gelangen.

Zusammenfassung.

Die Verfasserin berichtet zunächst über die Historik und ausführlich über die Technik der WEBER-RAMSTEDT'schen Operation. Das in der chirurgischen Abteilung des Maria-Krankenhauses aus den Jahren 1932—1943 eingesammelte Material umfasst 23 schwere Pylorospasmusfälle, die operiert wurden, nachdem die konservative Behandlung nicht zum Ziel geführt hatte. Von diesen genasen 18 rasch nach der Operation, während 5 starben: 1 an einer Lungeninfektion, 1 wegen seines zu schlechten Allgemeinzustandes, 3 an Operationsfolgen. Am besten ist eine kombinierte konservative und chirurgische Behandlung in enger Zusammenarbeit zwischen Kinderarzt und Chirurgen. Schwere Fälle müssen beiseite operiert werden. Bei ihnen würde die konservative Behandlung lange Zeit erfordern, in deren Verlauf das in schlechtem Zustand befindliche Kind Infektionen ausgesetzt ist: Eine richtig ausgeführte Operation dagegen führt schnell zum Resultat.

Summary.

The author reports the genesis of the WEBER-RAMSTEDT operation and gives a detailed description of this technique. During the years 1932 to 34 a total of 23 cases of severe spasm of the pylorus came for treatment to the Surgical Department of the Maria Hospital. Conservative treatment having been of no avail, they were subjected to operation. 18 cases were completely relieved from their troubles shortly after the operation, 5 died: 1 of an infectious pulmonary disease, 1 succumbed owing to his weak general condition and 3 died of postoperative sequels. The author suggests as treatment of choice combined conservative and surgical treatment in close collaboration with the surgeon and the pediatrician. Severe cases should be operated on at an early stage. In such instances conservative treatment takes a long time and therefore increases the risk of infectious diseases, to which the child, owing to his weakened condition, is exposed. A correctly performed operation, however, will quickly afford cure.

Résumé.

L'auteur commence par un rappel historique et un exposé technique circonstancié de l'opération de WEBER-RAMSTEDT. Le

matériel, des années 1932 à 1943, collationné à la Division Chirurgicale de l'Hôpital Maria, comprend 23 cas de pylorospasme sévère qui furent opérés après que le traitement conservateur n'eut pas conduit au but. De ces enfants 18 guérirent rapidement après l'opération tandis que 5 moururent: l'un d'une infection pulmonaire, un autre du fait de son mauvais état général, et 3 des suites de l'intervention. C'est un traitement combiné, à la fois conservateur et chirurgical, rendu possible par la collaboration étroite du pédiatre avec le chirurgien, qui est le meilleur. Les cas graves doivent être opérés à temps. Pour eux le traitement conservateur exigerait un temps prolongé, pendant lequel l'enfant en mauvais état général est exposé à des infections: en revanche une opération correctement exécutée aboutit promptement au résultat escompté.

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The Significance of Blood Group Characteristics in Serum and Plasma Transfusions.

By

KNUT HALVORSEN.

During the time when the blood groups were first taken into consideration on blood transfusions, investigations were made to determine that the serum of the recipient did not agglutinate or hemolyse the blood corpuscles of the donor, i. e. precaution was taken that no antigen (A or B) was administered which the recipient did not possess. In this manner a 0 blood donor could be used for all other groups, an A donor for A or AB and a B donor for B or AB while an AB donor could only be used for the same group. AB was a universal recipient.

Later the practice became to use a donor of the same blood group as the recipient. Thus it was possible to avoid transfusions of antibodies (agglutinins) which might eventually influence the blood corpuscles of the recipient.

The question of the justification of using group 0 as a universal blood donor however has never been dropped. It is also of considerable practical significance as in such cases it is not necessary to determine the group of the recipient. And many have used 0 individuals as universal donors in innumerable instances without observing any complications. However it appears certain that 0 blood with a high agglutinin titre in the serum can cause hemolysis in the recipient. Some authors claim to have observed these complications relatively often, thus E. HESSE (5) writes that he has observed 46 cases of hemolytic shock after transfusion of 0 blood to recipients of other groups, of which 20 were fatal. The question as to where the titre limit shall be set between universal and non-universal blood donors is very vague. HESSE claims that over 30

per cent of all O donors have a titre over 32, which he regards as the limit. Some other authors have also found similarly low figures for the titres. But these claims must be based on the fact that the titrations have been carried out by insufficiently sensitive methods as most of the more extensive investigations, and also those which we have made personally, show considerably higher titres. In a material from the Norwegian Red Cross Blood Donor Organization in Oslo of 756 O donors, we found only 11 or 1.5 ± 0.4 per cent with a titre of 32 or less both against A₁ and B blood corpuscles, while 423 or 56.0 ± 3.3 per cent had a titre of 256 or less both against A₁ and B corpuscles. 333 or 44.0 ± 3.3 per cent had a titre of 512 or more against A₁ and B corpuscles. The titres ranged from 4 to 4096.

It thus appears that by our method, using a titre limit of 256, we exclude a larger number of O blood donors than HESSE with his less sensitive method and a titre limit of 32.

In order to separate out the O blood donors with the highest agglutinin content, COCA (1) has reported a method which eliminates about 3 per cent of the O donors. HARTMANN and BJERKE-LUND (3) have described a very simple method which eliminates about $\frac{1}{5}$ of the O donors. This method can be modified, if so desired, by changing the degree of dilution, so that the titre limit may be set at the level considered most practical.

Many have held the opinion that the blood group characteristics can be completely disregarded in serum and plasma transfusions. But serum or plasma may both contain agglutinins which may have an effect on the blood corpuscles of the recipient, and antigens, which may react with the agglutinins of the recipient. Recently POLAYES and SQUILLACE (8) have described a strong reaction after a plasma transfusion, which they ascribe to the high agglutinin content of the plasma, and LEVINE (6) showed that the A and B antigens in plasma also can cause reactions after transfusions.

It was early demonstrated that the blood group characteristics A and B were not related only to the red blood corpuscles, but that the organism as a whole exhibited these group characteristics to varying degrees. For example it has been found that saliva often has a high antigen content. In 1932 SCHIFF and SASAKI (9) demonstrated that some individuals possessed blood group characteristics in the saliva (secretors) while others lacked this property (non-secretors). The secreting capacity was found to be hereditary.

In 1930 THOMSEN (10) showed that also serum contained A and B antigen. This has been confirmed by a number of other investigators, most recently by GRETE HARTMANN (4) in 1941. She also claimed to have demonstrated that the antigen content in the serum was higher in secretors than in non-secretors. The antigen content of the serum is however always very much less than the antigen content of the red blood corpuscles.

The reaction between the antigen in the serum and the corresponding agglutinin can be demonstrated *in vitro* as a precipitation, as shown by DOLD and ROSENBERG (2). This phenomenon is, however, difficult to reproduce, and according to THOMSEN (11) it is probably only possible by the use of agglutinins with high titres. In spite of numerous attempts, we have only observed precipitation in a few cases, and then only with agglutinins with high titres (2048—4096). By carefully placing the one serum above the other there appeared in these cases a marked, white precipitation on the contact surfaces, which consisted microscopically of very fine down. Thus the possibility cannot be eliminated that similar reactions may occur in the organism, if an antigen which the recipient does not possess, is administered in serum or plasma transfusions. If it is allowable to draw conclusions from experiments *in vitro*, these complications should occur preferably in recipients with a high agglutinin titre.

In 1940 LEVINSON and CRONHEIM (7) pointed out that there is a considerable reduction of the serum agglutinins when two sera of contrasting groups (A and B) are mixed. But the method used in these investigations was not absolutely accurate; the titres, as in HESSE's case, are far too low because the method was not sufficiently sensitive. The border between universal and non-universal blood donors was set at titre 32.

The reduction in titre occurs when some of the agglutinins in the one serum react with the corresponding antigen in the other serum. If there are still agglutinins present after mixture, all of the antigen has been bound while the agglutinin is only partially bound.

In order to investigate to what extent the agglutinins are absorbed by the corresponding antigen, we have made a series of experiments with mixtures of A₁ and B sera, and with O and A₁ or B sera.

A total of about 30 different mixtures were examined. Among those tested were both secretors and non-secretors, which was determined in saliva by the ordinary method of agglutinin inhi-

bition. No certain difference could be demonstrated between secretors and non-secretors with regard to the antigen content of the serum, which is in agreement with Grete Hartmann's results insofar as she was not able to demonstrate any such difference except by using A_2 corpuscles for the titration.

The experiments were carried out by titration in small test tubes. In order to obtain the most accurate measure of the titre, a titration was first made in a geometric series. When this method had revealed in which interval the agglutinin titre lay, more new series of different dilutions was made up until the dilution which gave barely macroscopically visible agglutination was found. This dilution was taken as the agglutinin titre. In order to insure the greatest possible accuracy in the observations, each experiment was set up in 6 parallel dilution series which was done by carrying out the titration in 6 times the individual quantity of fluid, and dividing each dilution into the 5 other series under the titration. In this manner it should be possible to avoid inaccuracies in titration. The blood corpuscle suspension used was $\frac{1}{2}$ per cent. The observations were read after at least 4 hours in a refrigerator and $\frac{1}{2}$ hour at room temperature. Some of the observations were also made after 3 minutes shaking of the serum-blood corpuscle mixture and about 10 seconds centrifuging of the glasses with about 2000 revolutions per minute. When using the rapid centrifuge method it is very important that the glasses be shaken before centrifuging, otherwise the titre will be too low. Parallel experiments were carried out which showed that both of the methods employed gave the same results.

By titrating the agglutinin before absorbtion by this method, and after absorbtion with equal parts of serum containing the corresponding antigen, it was possible to determine the agglutinin absorbing capacity of this antigen.

The observed reduction in titre varied some, but was in most cases around 100.

It was further investigated whether the agglutinin absorbtion occurred momentarily or whether there was a gradual reduction over a longer period. By using the centrifuge method it was demonstrated that the reduction in the titre a few minutes after mixing was the same as after hours, days and 1 months storage in a refrigerator, or, in other words, the reaction between the antigen and the antibody takes place instantaneously when the mixture is made.

A series of experiments were also performed to determine whether the reaction between the agglutinin and the antibody in the serum used up any of the serum's complement. In these experiments we used A₁ and B blood, which was defibrinated and centrifuged immediately after collecting. Each serum alone and a mixture of equal parts of each serum was then titrated for its complement content with the help of a hemolytic system with $\frac{1}{2}$ per cent sheep blood corpuscles. The experiments were also made with a hemolytic system with human blood corpuscles of group 0 and corresponding amboceptor. In order to obtain the highest possible degree of accuracy both the smallest dose which gave complete hemolysis and the smallest dose which gave beginning hemolysis were titrated. By a comparison of the complement titre in each individual serum and in the mixture, both immediately after collecting and after 1 day in the refrigerator, we were not able to demonstrate that any of the complement had been used by the reaction between the agglutinins and the corresponding antibody.

When there is opportunity to do so in the preparation of serum or plasma for therapeutic use, the blood group characteristics should be eliminated as far as possible. For the present this is impossible in serum from a single individual as it will always contain two characteristics, either two agglutinins (0), or one agglutinin and one antigen (A and B) or two antigens (AB). The only serum from a single individual which lacks these characteristics are sera from group 0 who have no demonstrable agglutinins. But this is very rare and can have no practical application. In about 5,000 examinations of 0 blood donors we have found only one such serum.

The situation is different if mixtures of sera from various individuals are used. The mixture can be made either by mixing citrate blood or by mixing only plasma or serum.

In the former case the various blood portions are cooled to about 5° C and mixed at this temperature, and centrifuged (separated) immediately afterward. This is to avoid hemolysis as far as possible. By selecting suitable mixtures it will be possible to obtain agglutinin-free serum even though the agglutinin titre in the individual portions may be high, as the erythrocytes absorb large quantities of agglutinin. We have examined the serum antigens A and B in such mixtures of whole blood, and it was found that they are not removed but in some cases there was a considerable reduction.

To obtain a mixed serum of whole citrate blood with the least possible blood group characteristics, a suitable mixture would be the ratio 2 O, 1A, 1B. Even if the A employed were A₂ the quantity of agglutinin would be sufficient to remove all the agglutinin, even if the O blood employed had a very high titre. The remaining quantity of agglutinin in the serum will be very small with these proportions.

If only the plasma or serum from different individuals are mixed, the blood group characteristics in the mixture will be dependent on the agglutinin titres of the individual sera. Thus among 860 A blood donors in the Norwegian Red Cross Blood Donor Organization in Oslo there were 204 with an anti-B titre of 64 and 198 with a titre of 128, together almost half of the A blood donors. Among 143 B blood donors 16 had an anti-A titre of 64 and 30 a titre of 128, together about one third of the B blood donors (see the table). If A and B sera from a number of individuals within this titre range are mixed, a mixed serum will be obtained which is practically free of blood group characteristics, as it will contain only very weak antigens or agglutinins.

Distribution of the Agglutinin Titres in 860 A and 143 B Donors.

A Donors		B Donors	
Agglutinin Titres	Numbers	Agglutinin Titres	Numbers
4	3	4	
8	12	8	
16	37	16	2
32	109	32	3
64	204	64	16
128	198	128	30
256	165	256	35
512	85	512	29
1024	32	1024	17
2048	8	2048	7
4096	7	4096	4
	860		143

Serum or plasma for therapeutic use should be plainly marked with information on the method of production: mixture of whole blood or plasma, which blood groups are used and their proportions

in the mixture, anti-A and anti-B titre. The antigen content in the mixture is more complicated to determine, but will, as described above sufficiently appear from the other information.

Summary.

Every human serum contains either agglutinins (blood group 0) or agglutinogens (blood group AB) or both (blood groups A and B). The agglutinins may have an effect on the red blood cells of the recipient, and the agglutinogens may react with the agglutinins of the recipient, the latter reaction can be demonstrated in vitro as a precipitation.

In producing serum and plasma for therapeutic use, consideration must be taken of the blood group characteristics, and it should be attempted to prepare a serum which is as free of these as possible. By mixing in suitable proportions, it is possible to prepare sera which are practically free of both anti-A and anti-B agglutinins as well as of antigens (agglutinogens) A and B.

If citrated blood is used, the proportions 2 0, 1 A, 1 B as an example, will give a mixed plasma which is free of isoagglutinins and contains little antigen A and B, regardless of the agglutinin titre of the individual components.

If only serum or plasma are mixed, a mixture of equal parts A₁ and B serum or plasma with an isoagglutinin titre of 64—128 (titrated in test tubes with one half per cent blood corpuscles) will be practically free of both isoagglutinins and antigen A and B. About half of the A donors and one third of the B donors can be expected to lie within this titre range.

Zusammenfassung.

Über die Bedeutung der Blutgruppeneigenschaften bei Serum- und Plasmaübertragungen: Jedes menschliche Serum enthält entweder Agglutininen (Blutgruppe 0) oder Agglutinogene (Blutgruppe AB) oder beide (Blutgruppen A und B). Die Agglutininen können die Blutkörperchen des Empfängers beeinflussen, und die Agglutinogene können mit den Agglutininen des Empfängers reagieren, die letztgenannte Reaktion kann in vitro als eine Präzipitation gezeigt werden.

Bei der Herstellung von Serum und Plasma zu therapeutischen Zwecken müssen die Blutgruppeneigenschaften berücksichtigt

werden, und zwar in der Weise, dass man bestrebt sein muss, ein Serum herzustellen, das davon möglichst befreit ist. Durch zweckmässige Mischungsverhältnisse können Sera hergestellt werden, die praktisch genommen von sowohl Anti-A als Anti-B-Agglutininen wie auch von Antigenen (Agglutinogenen) A und B frei sind.

Verwendet man Zitratblut, wird man z. B. durch das Verhältnis 20 — 1 A — 1 B, unabhängig von den Agglutinintitern der einzelnen Bestandteile, ein Mischplasma erhalten, das von Isoagglutininen frei ist und nur wenig Antigen A und B enthält.

Vermischt man das abgezogene Serum oder Plasma, wird man z. B. durch die Mischung gleicher Teile von Serum oder Plasma A₁ und B mit Isoagglutinintiter von 64—128 (in Reagensgläschen mit ½ % Blutkörperchen titriert) ein Mischserum erhalten, das praktisch genommen sowohl von Isoagglutininen wie auch von Antigen A und B frei ist. Man kann erwarten, etwa die Hälfte der A-Spender und ein Drittel der B-Spender innerhalb dieses Titerbereichs zu finden.

Résumé.

Sur l'importance des propriétés des groupes sanguins pour les transfusions de sérum et de plasma: Tout sérum humain contient des agglutinines (groupe sanguin O) ou des agglutinogènes (groupe sanguin AB) ou bien tous les deux (groupes sanguins A et B). Les agglutinines peuvent influencer sur les globules du récepteur, et les agglutinogènes peuvent réagir avec les agglutinines du récepteur; cette dernière réaction peut être démontrée in vitro comme une précipitation.

En préparant du sérum et du plasma à l'usage thérapeutique, on doit tenir compte des propriétés des groupes sanguins, étant donné qu'on doit tâcher de préparer un sérum autant que possible exempt de celles-ci. Au moyen de dosages convenables on peut préparer des séra qui sont pratiquement exempts et d'agglutinines anti-A et anti-B et aussi d'antigènes (agglutinogènes) A et B.

Si l'on emploie du sang citraté, on obtiendra par exemple par la proportion 20 — 1 A — 1 B, indépendamment des titres d'agglutinine dans les ingrédients respectifs, un plasma mélangé exempt d'isoagglutinines et contenant peu d'antigène A et B.

Si le sérum ou plasma soutiré est mélangé, on aura, en mélangeant par exemple des parties égales de sérum ou plasma A₁ et B au

titre d'isoagglutinine de 64—128 (titrées dans un tube à essai avec $\frac{1}{2}$ % de globules) un sérum mélangé pratiquement exempt d'isoagglutinines et aussi d'antigène A et B. On peut s'attendre à trouver à peu près la moitié des donneurs A et un troisième des donneurs B dans cet ordre de titrage.

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From the Second Surgical Service of the Sahlgrenska Hospital.
(Surgeon-in-chief: Dr. A. WESTERBORN.)

Nailing in the Marrow Cavity in Cases of Recent Fracture and Psendarthrosis.¹

Report of 28 Cases.

By

ANDERS WESTERBORN.

It was at the Surgical Congress in Berlin in 1940 that KÜNTSCHER first presented for a large audience his experience with nailing in the marrow cavity and the results of his animal experiments. His method was then subjected to fairly sharp criticism. Today about forty papers have been published on this method of treatment and, though now and then a word of warning is still heard, most surgeons who have tried it out are highly enthusiastic. At the University Surgical Hospital in Kiel, where KÜNTSCHER is the first surgeon, the operation has been done in between three and four hundred cases, and the results are on the whole most encouraging.

The principle of the method, as known, is to fix the fragments, when they have been put into proper position, by a nail inserted into the marrow cavity. As the nail is driven in from an incision far from the site of the fracture, the latter is not exposed, and thus it is not a question of open reduction. The first time one saw the roentgen pictures of medullary nailing, one was taken back and thought that it involved more violence than the situation required. The pictures gave the impression that it was a question of a round, metal nail filling the whole marrow cavity. But this is not the case. The nail is really U-or V-shaped and acts in about the same way as the three-winged nails used for fractures in the femoral neck. Because the nail has this shape, it causes very little damage

¹ Read before Swedish Society of Surgeons Nov. 30. 1943.

to the endosteum and the bone marrow, but nevertheless produces extremely firm fixation. As figure 1 shows, the nail reaches the endosteum in only three narrow places, and thus one can hardly speak of any destruction to this tissue, and since the nail is relatively thin, the bone marrow is only moderately compressed. Despite the fact that the nail is only one to two millimeters wide, its angulation makes it very resistant to flexion and, if it fits well in the marrow cavity, it provides absolutely firm fixation.

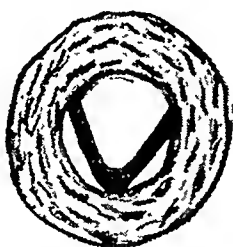


Fig. 1.

When it is a question of the femur, the nail is inserted from the upper surface of the trochanter, either through the skin or from a small incision. No boring is then needed, as the bone of the trochanter is so soft that it is easy to drive in the nail. In the case of the other long bones, the tibia, humerus, radius and ulna, however, a small hole must be chiselled or bored in the cortex at a suitable distance from the fracture. The greatest difficulty lies in obtaining such exact reduction by closed means that the nail can be inserted directly from one fragment into the medullary cavity of the other. Several different apparatuses for facilitating this reduction have been constructed. KÜNTSCHER strongly advocates closed reduction, as exposure of the fracture and open reduction involves risk of infection and other complications. But sometimes, as my cases show, it is necessary to use the open method for reduction of the fragments. If closed reduction can be done, the nailing itself is only a minor operation and puts little strain on the patient. This is one of the great advantages of the new method over the ordinary open method of reduction. The nail must be inserted under fluoroscopic supervision, or must be checked with several roentgenograms. I used the latter method and found it satisfactory. To avoid the risk of having to take out and change the position of the nail, one can first insert a "leader" (KIRSCHNER needle) as is the practice in fractures of the femoral neck.

As regards the indications for medullary nailing, no definite agreement has been reached. Some surgeons have narrow indications and others very wide ones. KÜNTSCHER says that the method is suitable for all transverse, oblique and spiral fractures in the long bones and PASCHER goes so far that he considers it absolutely indicated in all transverse fractures, all oblique fractures with a poor healing tendency or where there is risk of slipping, and in all fractures in old persons where long stays in bed should be avoided. BÖHLER, who is a strong opponent of open treatment for fractures, recommends the method warmly for gunshot fractures, thus open fractures, and seems to be a strong advocate of medullary nailing on the whole. Others, for example K. H. BAUER, reserve the method for more special cases, e. g. for times when it is necessary for some reason to make an open reduction, and KÖNIG is of the opinion that the method, used with strict indications, means a great advance in the treatment of fractures.

Judging from the literature, the method has hitherto only been used in Germany. Thus there are no reports on medullary nailing in the Scandinavian literature. Since during the last year I have tested the method in 28 cases, 14 of recent fracture and 14 of pseudarthrosis, with very encouraging results, I feel that the time has already come for me to record my experience. The cases are divided as seen in table 1.

Table 1.

	Recent fractures	Pseud- arthrosis
Femur	6	6
Tibia	3	2
Humerus	—	5
Radius or Ulna	5	1
	<hr/> Total 14	<hr/> 14

The nails we used were manufactured by Eriksson's Instrument Company in Gothenburg, according to the directions of Mr. SVEN JOHANSSON. They are made of rustless steel. The first ones we received were not durable enough, but those we now get are quite satisfactory. It is probable, however, that experience will show that still further modifications are necessary before the ideal nail is obtained. It is naturally necessary to have several nails of different lengths and widths on hand.

1. Recent Fractures.

Case 1. A man of 31 got an oblique fracture of the femur. Extension treatment not resulting in good position and roentgenograms showing that the fragments were interposed, medullary nailing was done on April 30, 1943. The interposition made open reduction of the fragments necessary. The nail was inserted from the upper surface of the trochanter major. A good position was immediately obtained with firm fixation and complete freedom from pain. The patient could sit up a week after operation and three weeks after he was able to weight his leg. When he was discharged seven weeks after operation, he walked easily with a cane. As seen in figure 2, there was an early and powerful callus formation. Because of advanced pulmonary tuberculosis, he is not capable of work. Fig. 2.

Case 2. A man of 25 got a transverse fracture in about the middle of the right femur on July 17, 1943. It proving impossible to keep the fragments in the desired position with extension, medullary nailing was done on August 12. The operation resulted in good position of the fragments, firm fixation and freedom from pain. A week afterwards the patient could sit up and after a further two weeks he could stand on and weight his leg. The callus formation was also early and powerful in this case. He was discharged on September 20. The nail was removed easily on December 15, about four months after operation. The mobility was good in all the joints the whole time without the use of any physical therapy. He could not return to work until about five months after operation, but he had a strenuous outdoor occupation.

Case 3. A woman of 45 sustained a complicated transverse fracture of the right femur on Nov. 14, 1943. Immediately on admission operation was done with careful removal of all the injured tissues, and the fragments were reduced by the open method. A marrow nail was inserted from the trochanter major. Primary suturing was done and healing was primary. As the fractured site was not made absolutely stable, another nail was inserted about a week later, with better results. The patient got up almost immediately, and was able to weight her leg two weeks after the second operation. Fig. 3.

Case 4. A man of 67 with transverse fracture a few fingerbreadths below the trochanter minor. Closed reduction impossible on account of interposition. On Jan. 28, 1944 open reposition and medullary nailing. Good position and fixation. The short proximal fragment will make some weeks' stay in bed necessary.

By the use of medullary nailing in these four cases we avoided all treatment with extension and plaster, and normal mobility returned to the joints without any physical treatment. Three patients could stand on the injured leg three weeks or so after the operation.

Case 5. A man of 56 sustained an oblique fracture of the tibia. On Nov. 8, 1943, marrow nailing was done, the nail being inserted through a small hole chiselled out in the upper part of the tibia, and without open reduction. The lower leg and foot were put in plaster of paris for four weeks. Six weeks after operation the patient could support himself well on the leg. Fig. 4.

In this case the fracture would most likely have healed without any intervention. But because of the medullary nailing, the patient was able to get up sooner, had less trouble, and was earlier able to weight his leg. In my present opinion, the plaster cast was unnecessary, and without it the patient could no doubt have stood on his leg sooner, to his consequent advantage.

Case 6. A man of 60 got an oblique fracture of the lower part of the tibia, with poor position of the fragments. Instead of osteosynthesis, I chose medullary nailing for fixation of the fragments (Nov. 15, 1943). The distal stump was too short to allow as firm fixation as was desired, and a plaster cast was applied for four weeks. The leg could be weighted five weeks after operation.

Case 7. A man of 20 acquired a transverse fracture of the radius and ulna. After repeated reductions, a good position of the ulna was obtained, but not of the radius fragments. Medullary nailing was therefore chosen instead of osteosynthesis, the nail being inserted through a little hole in the distal end of the radius. In order to get in the nail in the proximal fragment, it was necessary to make a small incision over the fracture and lift the fragments into position with an elevator. A plaster splint was applied for four weeks. The patient had recovered his working capacity six weeks after operation. Fig. 5.

Case 8. A woman of 45 sustained a transverse fracture of the radius and ulna. The position was exactly the same as in the foregoing case, and the same procedure was followed. She could return to work six weeks after operation.¹

In both last cases good stability was obtained in the arm after the operation and normal mobility returned to the neighboring joints without any physical treatment. A plaster cast was indicated in both these cases, as the ulna was not nailed and there was risk of disturbance of the fragments there on pronation and supination of the arm. The nail in the radius and the firm fixation there, however, also increased the stability of the ulna.

It is extremely important for the healing of the fracture that absolutely firm fixation is obtained in nailing in the medullary cavity. For this it is necessary to choose a nail which fits well

¹ Later as table 1 shows six more cases nailed. All with excellent results.

in the marrow cavity and that the latter is of fairly even width. This is true of the cavity in the femur and to a certain degree of that in the radius and ulna, but the tibia and humerus often have rather asymmetrical marrow cavities. Thus the best results are obtained in nailing of femoral fractures. The nail must be so wide that it establishes firm contact with the wall of the marrow cavity, mainly in order to hinder rotation between the fragments. One can see from the size of the marrow cavity in the roentgenogram about what size nail to choose. According to FISCHER, with a focal distance of 75 cm., the marrow cavity is really 1 mm. smaller than it appears in the roentgen picture. The conditions are not so favorable in the tibia as they are in the femur, for here the cavity is narrowest in the middle. Consequently, it is easy to obtain firm fixation of fractures situated in about the middle of the tibia but not of ones situated more distally or proximally.

If full stability is not obtained with one nail, it is wise to insert another one (case 3). This needs to be done more often in the case of bones with an uneven medullary canal (tibia and humerus) than of ones with an even canal. To still further ensure stability, MATZ recommended inserting a narrow wedge in between both nails. He also constructed double nails, which go apart distally, "Dreh-spreiznagel", particularly suitable for bones where the point comes to lie in more spongy tissue, e. g., the lower part of the tibia.

Medullary nailing has given the best results in fractures of the femur. The advantages of this method are also greatest in these cases. Previously, the patients had to lie in bed for two or three months and undergo extension treatment for long intervals, a procedure which is troubling for the patient and requires much work from the hospital staff. The long stay in bed also involves the risk of complications in the air passages, at least in older persons. Now these patients can be let up immediately and can soon begin to weight their leg, avoiding stiffness in the joints and muscular atrophy. Another great advantage is that the patients are immediately rid of pain. It is also maintained, by KÜNTSCHER and others, that the nailing accelerates the formation of callus, thus considerably reducing the time before the patient is able to resume his normal occupation. — FISCHER also recommends medullary nailing for supracondylar femoral fractures. The greatest advantage in these cases is that the nail keeps the fragments in position, which is difficult to obtain with extension treatment.

The nail can only be inserted two or three centimeters in the distal fragment when such fractures are present, and consequently a plaster cast is necessary for some weeks and early weighting is out of the question.

The *advantages* of medullary nailing, particularly in cases of femoral fractures, are in my experience and that of others:

1. Shortened stay in bed.
2. Simplified treatment — no extension.
3. Reduced pain and other subjective troubles.
4. Less risk of stiff joints, muscular atrophy and circulatory disorder.
5. No postoperative physical treatment.
6. Shorter hospitalization and probably earlier acquirement of working capacity.

What, then, are the *risks* of medullary nailing? What, in particular, is the danger of destruction of the bone marrow, fat embolism and osteomyelitis? Experience has already shown that the damage the nail causes to the bone marrow is of no practical significance. It is recommended, however, that the nail be removed when full consolidation is established. This is a simple operation. After a few months the nails generally lie fairly loose in the marrow cavity. On the other hand, there is a certain risk of fat embolism. At least two deaths from fat embolism after medullary nailing are reported (KÜNTSCHER and HÄBLER). Detailed information is lacking, and it is impossible to decide whether the fat embolism occurred as a result of the fracture or of the nailing. Osteitis has developed in a few cases (KÜNTSCHER, FISCHER and others). In most of them it was a question of nailing for complicated fractures. Extended osteomyelitis generally does not develop, but only restricted osteitis with local sequestration, mainly due to the fact that the pus in the marrow cavity is led off along the nail. Thus, according to KÜNTSCHER, BÖHLER and others, there is never any enclosure of pus in the cavity with rise in pressure, which is generally considered to be the cause of extended osteomyelitis. KÜNTSCHER says that whenever there is infection, one should drain so that the pus is easily able to run off, but not remove the nail since it generally heals in despite the infection. If it is removed, the infection grows worse because the fragments are moved out of position.

2. Pseudarthrosis.

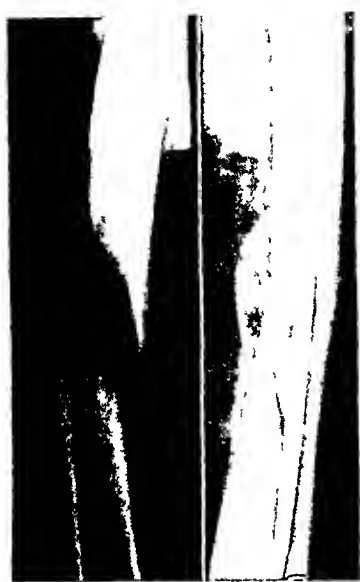
Medullary nailing has also been used for pseudarthrosis. Pseudarthrosis is extremely common after infected gunshot injuries. Thus in the warring countries the treatment of this condition is a very important and difficult problem, which the method of medullary nailing will no doubt greatly simplify. The literature on this field is still more scanty. BAUER, who is very reserved regarding the new method otherwise, recommends it for pseudarthrosis and reported a few number of successful cases. CELLARIUS from Kirschner's hospital reported the results of treating 18 cases of pseudarthrosis, earlier treated to no avail with other methods. In at least 15 of the cases, osseous healing took place within five to eight months, with restored function and working capacity.

I have tested the method in 14 cases with hitherto excellent results. Because of the few cases in the literature, I shall now give a brief description of my cases. All except two of the patients were Finnish war invalids.

a) Pseudarthrosis in the Thigh Bone.

Case 9. A 22-year-old sergeant got a gunshot fracture of the femur a few fingerbreadths below the trochanter minor on Oct. 22, 1941. He was treated in Finland with extension, plaster cast, etc. He arrived at the Sahlgrenska Hospital on July 22, 1942 with his leg in a plaster cast. When the plaster was cut up, the bone ends slipped apart. The wound was revised, sequestrotomy performed, and wire extension instituted. No healing taking place, osteosynthesis with transplantation of bone shavings according to LEVANDER was done in December. Consolidation did not result, and in March 1943 medullary nailing was done after revision with freshening of the bony ends. Firm fixation was obtained at the site of fracture, and three weeks later the patient was able to walk about outdoors with two canes and well able to weight the leg. When he returned to Finland in October, six months after the operation, the fracture was consolidated and he walked well. Fig. 6.

Case 10. A 34-year-old soldier acquired a complicated femoral fracture through a shell injury in December 1941. It was treated with extension. On admission to the Sahlgrenska Hospital in February 1943 the wound was healed but the bone was not stable. Medullary nailing was performed on March 27 after freshening of the bony ends and excision of all fibrous tissue. Firm fixation was immediately obtained and full stability at the site of fracture. Two weeks later the patient was able to stand on his leg. After another two weeks he walked well.



a b

Fig. 2. Case 1.

- a. Fracture with interposition.
- b. Six weeks after marrow nailing.



a b

Fig. 3. Case 3.

- a. Open fracture of the femur.
- b. After marrow nailing.



a b

Fig. 4. Case 5.

- a. After nailing.
- b. Six weeks later.



a b

Fig. 5. Case 7.

- a. Fracture of the forearm
- b. After nailing.



Fig. 6 Case 9.
 a Pseudarthrosis of the femur.
 b. Osteosynthesis, no consolidation.
 c. After marrow nailing.
 d. Six months later, osseous healing.

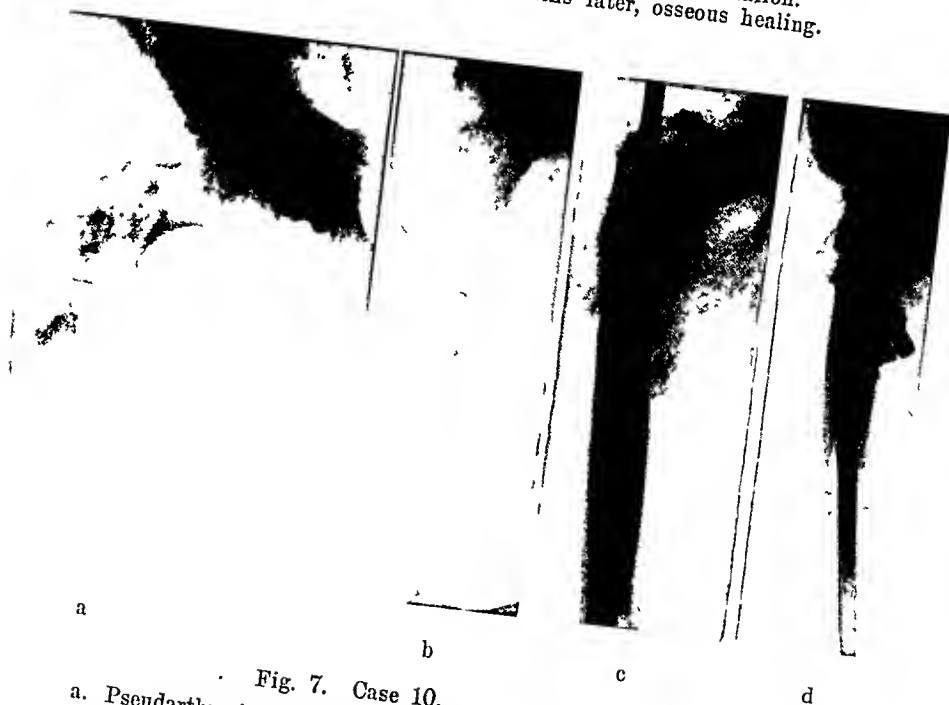


Fig. 7. Case 10.
 a. Pseudarthrosis femoris.
 b. After reposition.
 c. Marrow nailing.
 d. Three months later.



Fig. 8. Case 12.

a. Pseudarthrosis of the femur. b. After marrow nailing. c. Three months later.

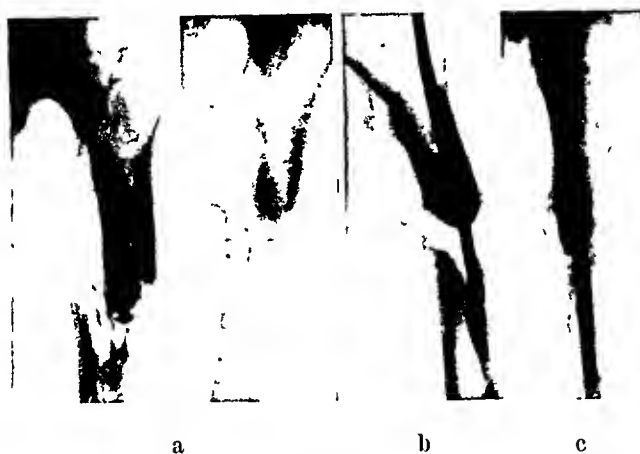


Fig. 9. Case 13.

a. Pseudarthrosis of the femur. b. After marrow nailing. c. Three months later.



Fig. 10. Case 15.

a. Pseudarthrosis of the humerus. b. Osteosynthesis without healing.
c. After marrow nailing. d. Four months later, it seems to be bony healing.



Fig. 11. Case 18.

a Pseudarthrosis of the radius in two places b. After nailing.

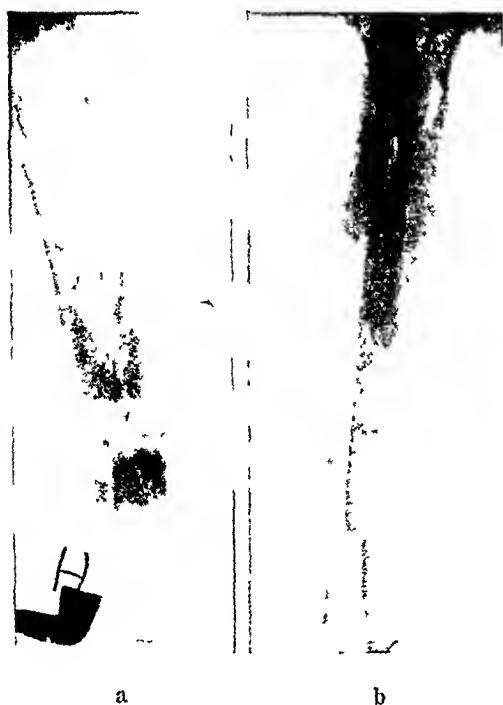


Fig. 12. Case 19.

a. Pseudarthrosis humeri.
b. Three months after last marrow nailing.



Fig. 13. Case 20.

a. Pseudarthrosis of the tibia.
b. Three months after nailing.

with two canes. When he was discharged three months after operation, the bone was stable, he could walk well and there was increased callus formation. Reports from Finland say that full consolidation has occurred. Fig. 7.

Case 11. A 25-year-old soldier got a gunshot fracture in the upper part of the femur in July 1941, which was complicated by prolonged suppuration. Extension treatment and sequestrotomy were done in Finland. On admission to the Sahlgrenska Hospital in July 1942 there was a suppurating fistula and a marked pseudarthrosis. Sequestrotomy was performed. In March 1943 osteosynthesis was done after revision of the wound. Extension was applied but no healing resulted. Two and a half months later, the wound was again revised and medullary nailing done. The infection did not grow worse. As the nail was too weak, the bone bending, another one was inserted about a week later. This led to complete stability of the bone and three weeks later only, it could be weighted. When he returned to Finland in November the wound had healed, he walked well and the bone was absolutely stable. Roentgenograms showed increased callus formation, so it may be hoped that osseous healing soon took place.

Case 12. A 27-year-old soldier was hit in March 1940 by a shell splinter which caused a complicated femoral fracture. He was treated with extension and a plaster cast. On admission to the Sahlgrenska Hospital in February 1943, three years after the fracture, pseudarthrosis had developed. The leg was considerably shortened, the knee was ankylotic and there was paralysis of the peroneus muscle with severe muscular atrophy. The patient could not stand at all on the leg. In February osteosynthesis with bone transplantation was done. Since there were no signs of healing, two months later the pseudarthrosis was again revised with excision of all the fibrous tissue and freshening of the bony ends, and medullary nailing was done. Firm fixation and freedom from pain were immediately obtained and the patient, who had been in bed for nearly three years, was able to begin to stand on his leg after about a week. When he returned to Finland three and a half months after the operation, he stood well on his leg and walked with two canes. The bone was absolutely stable but there was only a slight increase in callus formation. It seems as if there is going to be bony healing in this case as well. Fig. 8.

Case 13. A 24-year-old corporal acquired a complicated thigh bone fracture in December 1941. When he came to the Sahlgrenska Hospital in July 1942, pseudarthrosis had developed, and pus supplicated from fistulas on the anterior and posterior sides of the thigh. Sequestrotomy was done first, and five months later osteosynthesis with transplantation of small pieces of bone according to Levander's method. No healing took place, and suppuration began again. On June 22, 1943, six months later, medullary nailing was done after freshening of the bony ends. The nail fastened, however, in the compact tissue on the distal fragment and could not be inserted far enough and the

desired stability was not obtained at the site of fracture. A new operation therefore was performed in October, with insertion of another nail and transplantation of a piece from the tibia. This led to firm fixation, primary healing of the wound and a week later the patient could stand on his leg. When he returned to Finland in December he could walk fairly well and there seemed to be good signs of osseous healing. Slight suppuration took place after the operation in this case, and the possibility of detachment of a small sequestrum cannot be excluded. Fig. 9.

Case 14. A 22-year-old soldier got in July 1942 a complicated right-sided subtrochanteric femoral fracture with total lesion of the ischiadic nerve. He arrived at the Sahlgrenska Hospital in February 1943 with suppurating fistulas and no stability at the site of fracture. After sequestrotomy the wound healed. In August medullary nailing was done despite the high position of the fracture. Bony healing occurred afterwards, but the patient walks badly because of the injury to the ischiadic nerve.

In the six cases just described, the pseudarthrosis of the thigh bone persisted for one and a half to three years and, despite attempts with many different methods, it was not possible to attain osseous healing. In several of the cases all our old possibilities were exhausted and it is probable that the patients would have been left with the pseudarthrosis for the rest of their lives if we had not resorted to medullary nailing. It was also a great mental relief to these invalids to be rid of pain and be able to get up immediately after the nailing. Two of them had been confined to bed practically continuously for two or three years. In all the cases the nail was inserted from the upper surface of the trochanter and before insertion the wound was revised with excision of fibrous tissue and freshening of the bony ends. Since the fracture was exposed in these cases, it was not difficult to get the fragments into such a position that the nail came into the marrow cavity of the distal fragment. In two of the cases, persisting fistulas with a slight discharge were present at the time of operation. In one case the fistula healed soon after the operation and in the other there was still slight suppuration at the time the patient was discharged. In order to avoid the risk of re-activation of a latent infection, sulfathiazole was strewn in the operation wound in all the cases. The postoperative treatment was the simplest imaginable. After one or two weeks in bed, the patient was allowed to get up. The prolonged stay in bed before the operation had produced more or less marked stiffness in the joints and muscular atrophy, which necessitated intensive physical therapy.

As regards the permanent results, in at least four cases consolidation had developed before the patient was discharged. The others returned home so early that the final results could not be judged. There is much to indicate, however, that osseous healing will take place within a reasonable time in these cases as well. Even if the results may not be one hundred per cent perfect, experience up to the present indicates that the new method is vastly superior to the old ones for the treatment of femoral pseudarthrosis.

Wherein do the advantages of medullary nailing lie and why is it that it has such a favorable effect in cases of pseudarthrosis? The most important condition for osseous healing is, of course, absolutely firm fixation of the fragments, and particularly firm fixation is just what is obtained with medullary nailing. Another important factor is early weighting, and after medullary nailing the patient can almost immediately begin to weight his leg.

b) Other Kinds of Pseudarthrosis.

Case 15. A 25-year-old Finnish soldier was injured in the arm by a shell splinter in August 1941. A defective pseudarthrosis followed. After repeated revision, osteosynthesis was done on Sept. 7, 1942, but no consolidation resulted. Medullary nailing was done, therefore, on June 11, 1943. The nail could not be placed centrally in the peripheral stump and the site of fracture was consequently not stable afterwards. Another nail was driven in on October 26 after extraction of the former one. (Fig. 10.) Nor was this nail inserted in the ideal position. To increase the stability, a piece was taken from one of the tibias and laid over the fracture. The wound healing was primary and good stability resulted. Mars 1944. Osseous healing.

Case 16. A 30-year-old Finnish soldier received a gunshot injury in his right upper arm on July 24, 1941. A pseudarthrosis resulted. After repeated revision and sequestrotomy the wound healed. On Jan. 21, 1943, the bone ends were freshened and bone was transplanted. Suppuration followed and the inserted piece of bone had to be removed. On October 21 medullary nailing was done. It was only with great difficulty that the nail could be inserted in a more or less acceptable position. A short time later the wound was incised and a small amount of pus drained off. The wound still discharges slightly. The nail keeps the fractured ends in good position and is therefore not removed.

Case 17—18. A 21-year-old Finnish soldier sustained a complicated fracture of the right upper and forearm in February 1943. Pseudarthrosis developed in both places. He arrived at the Sahlgrenska Hospital in June, and on June 22 medullary nailing was done for the humerus

pseudarthrosis after excision of the fibrous tissue. The nail could not be placed in the desired central position and full stability was not obtained. The arm was therefore put in a plaster cast. On November 12 a medullary nail was inserted in the radius since, despite prolonged conservative treatment, no stability was obtained. This bone was fractured in two places and the nail was driven in from the distal end of the radius through the intermediate fragment a long way into the proximal one. Excellent stability resulted. (Fig. 11.) However, slight suppuration occurred afterwards. When the patient returned to Finland on Jan. 3, 1944, the fracture in the humerus felt consolidated, roentgenograms showed only moderate callus formation, and the suppuration in the forearm had almost entirely dried up.

Case 19. A woman of 70 sustained a fracture of the right humeral diaphysis on Oct. 17, 1941. Osteosynthesis with cerclage was done. The threads cut in and typical pseudarthrosis developed. On July 27, 1942, the bony ends were revised and a large amount of bony shavings were transplanted in according to the method of LEVANDER. No healing resulted, and a new operation was performed on Jan. 8, 1943, with transplantation of a bony plate from the tibia over the place of pseudarthrosis. The fracture still did not heal. On May 15 two fairly narrow nails were inserted. Roentgenograms in October showed that the nails had broken in the middle of the pseudarthrosis. On October 22 the broken nails were extracted and two coarser ones were inserted after revision of the pseudarthrosis with removal of the fibrous connective tissue. Full stability was then obtained and Febr. 1, 1944 röntgenograms showed that osseous healing has entered three months after the last medullary nailing. Fig. 12.

Case 20. A man of 35 got a complicated fracture in his lower leg in February 1942, resulting in prolonged suppuration and pseudarthrosis. In October 1943 medullary nailing was done after chiselling off the end of fibula, excision of the fibrous tissue in the pseudarthrosis and chiselling off of the tibial ends. (Fig. 13.) Plaster was applied. The wound healing was primary. Six weeks later the leg could be weightied. Good stability was obtained.¹

The last six cases were operated on so recently that nothing definite can be said about the final results in 4 of them. In two of them however we still have got consolidation. Case 19 is of greatest interest: The 70 year old woman with a 3 year old pseudarthrosis of humerus shows osseous healing 3 months after marrow nailing. Before we have proved all our old methods to get bony healing (osteosynthesis, bone transplantation etc.) to no purpose.

It is more difficult to do the nailing in cases of pseudarthrosis than in those of recent fracture. The sclerosis in the ends of the bone offers powerful resistance and may even make it impossible

¹ Later are two more cases nailed (Table 1).

to insert the nail. Thus in one case not reported herein it was not possible to drive the nail through the strongly sclerotic bone (tibia) and medullary nailing could not be carried out. The inserted nail sat so firmly in the bone that it could not be drawn out and a piece of it had to be left there.

In conclusion, I should like to express my opinion that medullary nailing for both recent fractures and pseudarthrosis constitutes a very great advance in the treatment of fractures and already now it can be said that this so-called "stable osteosynthesis" is in many respects superior to the old methods of treatment, particularly the old forms of osteosynthesis. To my mind, it will involve an equally great revolution in the treatment of fractures in the femoral diaphysis as the method of nailing in the neck did to the treatment of fractures in the femoral neck.

Summary.

Küntscher's method of inserting nails in the marrow cavity for fractures has already been practised a great deal in Germany. Thus in the Kiel University Surgical Hospital between three and four hundred fractures have been nailed and many successful cases have been reported from other hospitals. After a description of the technic the writer gives a report of his own cases, 14 of recent fractures and 14 of pseudarthrosis. The method is suitable for all transverse, oblique and spiral fractures in the long bones, particularly the femur. If the nailing is successful the patient can begin to weight his leg after only a week or two in bed. The method thus does away with long stays in bed, plaster and extension treatment, and no muscular atrophy or stiff joints develop. KÜNTSCHER strongly advocates bloodless reduction but, in the experience of the writer, the closed method is not always feasible. Osseous healing took place soon in the writer's cases. As regards the risk of this method, it causes only insignificant injury to the bone marrow, and when the fracture does not need to be exposed, there is but slight risk of infection. If infection occurs it takes the form of restricted osteitis, never of extended osteomyelitis. There is a little risk of fat embolism and two deaths from this complication are reported in the literature.

The writer also had good results with medullary nailing in cases of pseudarthrosis, where it ensures absolute stability of the

fractured site and allows early weighting, two important requisites for healing. It is important for the healing, of course, to freshen the ends of the bones and remove the connective tissue between them. The writer used Küntscher's method in six cases of pseudarthrosis of femur (*war invalids*) which had been present for one and a half to three years and had earlier resisted many other forms of treatment. It seems to be osseous healing in all six cases. Four of the other cases of pseudarthrosis are so newly nailed that it is impossible to judge the final results. In two entered full consolidation within three months.

Zusammenfassung.

Die von KÜNTSCHER eingeführte Marknagelung bei Frakturen der langen Röhrenknochen ist in Deutschland schon zu sehr grosser Anwendung gekommen. So hat man an der Chirurgischen Klinik i Kiel 300—400 Frakturen genagelt, und von mehreren anderen Kliniken sind viele erfolgreiche Fälle mitgeteilt worden. — Nach einer Beschreibung der Technik berichtet der Verfasser über sein eigenes Material: 14 frische Frakturen und 14 Pseudoarthrosen. Das Verfahren eignet sich für alle Quer-, Schräg- und Spiralbrüche der langen Röhrenknochen. Vor allem gilt dies für die Femurfrakturen. Nach einer Bettruhe von 1—2 Wochen kann der Patient nach einer geglückten Femurnagelung beginnen, sein Bein zu belasten. Hierdurch werden lange Bettruhe, Eingipsen und Streckbehandlung mit Muskelatrophien und Gelenksteifheiten vermieden. KÜNTSCHER legt sehr grosses Gewicht auf unblutige Reposition. Diese ist aber nach den Erfahrungen des Verfassers nicht immer durchführbar. — In sämtlichen Fällen trat sehr bald ossöse Heilung ein. — Was die Gefahren betrifft, dürfte Verletzung des Knochenmarks keine praktische Bedeutung haben, und da der Bruch nicht freigelegt wird, ist die Infektionsgefahr gering. Bei Infektion entsteht gewöhnlich keine ausgebreitete Osteomyelitis, sondern nur eine begrenzte Osteitis. Gefahr von Fettembolien besteht, ist aber minimal. Zwei solche Todesfälle werden in der Literatur mitgeteilt.

Auch bei Pseudoarthrosen hat der Verfasser sehr gute Erfahrungen mit Marknagelung gemacht, da diese der Bruchstelle absolute Festigkeit verleiht und frühe Belastung gestattet: zwei sehr wichtige Faktoren für die Heilung. Natürlich ist Exzision

des sklerotischen Bindegewebes und Auffrischung der Knochenenden erforderlich. Der Verfasser hat 6 Fälle von Femurpseudoarthrose (Kriegsverletzte) genagelt, welche $1\frac{1}{2}$ —3 Jahre bestanden hatten und vorher vergeblich nach vielen anderen Methoden behandelt worden war. In sämtlichen Fällen scheint ossöse Heilung binnen 5—8 Monaten einzutreten. Von den übrigen 6 Fällen sind zwei Humeruspseudoarthrosen innerhalb 3 Monaten geheilt. Die 4 übrigen Fälle sind so kürzlich operiert, dass man sich nicht über das endgültige Resultat äussern kann.

Résumé.

Le clouage des fractures des os moelleux, dit à longues tubulures, lancé par KÜNTSCHER a déjà été beaucoup pratiqué en Allemagne. A la clinique chirurgicale de Kiel 300—400 fractures ont été ainsi traitées, et on peut se rapporter à plusieurs autres cas semblables bien réussis signalés par d'autres cliniques.

Après avoir spécifié sa technique l'auteur rend compte des cas traités par lui: 14 fractures fraîches et 14 pseudo-arthroses. La méthode est applicable à toutes fractures déviées, transversales et en spirales des os dit à longues tubulures, surtout quand il s'agit de cassures du fémur. Après une ou deux semaines de lit le patient peut après un clouage réussi du fémur commencer à forcer sur sa jambe. Par cette méthode on évite de longs séjours au lit, le plâtrage et le traitement par l'étirage ainsi que l'atrophie des muscles et les joints rigides.

KÜNTSCHER attache beaucoup d'importance à une jonction non sanglante. Selon l'expérience de l'auteur cela n'est pas toujours possible. Tous les cas ainsi traités ont abouti à une guérison très rapide des os. Quant aux risques; une blessure de la moelle doit être sans importance pratique, et, étant donné que la fracture ne se trouve pas dénudée, il y a peu de risques d'infection. En cas d'infection les ostéomyelithes qui s'y produisent ne sont en général pas très répandus, il y aura seulement une ostéite limitée. Même s'il est minime le risque pour des embolies de graisse existe. Deux tels décès sont relatés dans les annales médicales.

Pour les cas de pseudo-arthrose l'auteur a eu également de très bons résultats du clouage de la moelle, car cette méthode donne à l'endroit fracturé une stabilité absolue et permet un chargement de bonne heure, deux faits très importants pour la guérison.

D'abord il est naturellement nécessaire d'exciser le tissu lamineux et de rafraîchir le bout des os. L'auteur a cloué 6 cas de pseudoarthrose du fémur (blessés de guerre), il y a de cela 1 à 3 ans, et qui ont parfaitement subsistés. Les cas avaient été en vain traité par d'autres méthodes. Pour ces 6 cas il faut constater une guérison osseuse dans les 5 à 8 mois. Parmi les 6 autres cas 2 pseudoarthroses de l'humérus ont guéri dans 3 mois. Les 4 cas restant sont si récemment opérés, qu'on ne peut pas encore déclarer de résultat définitif.

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From the University Clinic, Copenhagen, Surgical Department C.
(Former Director: Professor AXEL LENDORF, M. D.)

On Thyrotoxicosis.¹

By

JOHN HERTZ, M. D.

The old clinical entity FLAJANI-GRAVE'S-BASEDOW'S disease has in the face of modern advanced science become insufficient. From the first time it was a purely clinical conception, later on a pathological picture was included, and now one of the most important classical criterions, the exophthalmos, is missing in two thirds of the cases designated as GRAVE'S disease. This is inconsequent. The exophthalmos must be considered a symptom among others; it may be present or it may be absent. When speaking about "thyrotoxicosis" we are on more sure ground even if we must admit that the thyrotoxicosis may have different causes.

Classification.

The thyrotoxicoses are most naturally classified in two main groups:

The primary and
The secondary.

The primary thyrotoxicoses include the forms which are due to hyperplastic processes in the gland, viz. the exophthalmic goitre and the conglomerate goitre. According to the most recent investigations, partly from America by RIENHOFF-RIENHOFF & LEWIS, partly by the author these two forms must be considered the same disease, the conglomerate goitre being a very early or a late stage of an exophthalmic goitre. The nodular appearance is caused by local involutions which arise either spontaneously or by means of iodine.

¹ Read before the Swedish Medical Association 7/12 1943.

8—441196. *Acta chir. Scandinav.* Vol. XC.

The secondary thyrotoxicoses comprise the cases that have occurred in a gland which is not otherwise thyrotoxic. Consequently, this term includes the neoplastic processes, adenomas, papilliferous tumors and carcinomas, further inflammatory processes and finally cases of induced thyrotoxicosis caused either by iodine or by X-ray treatment.

"Thyrotoxic Adenoma".

The term "thyrotoxic adenoma" has literally caused many misunderstandings. It must, however, be emphasized that this term should be applied only to cases in which the goitre really is nodular

Survey of a material operated by the author.

Thyrotoxicoses	Primary	Exophthalmic goitre	83	
		Conglomerate goitre	8	
	Secondary	Adenoma (In certain cases induced thyrotoxicosis)	Toxic nodular goitre	2
		Carcinoma		
		Inflammatory lesions	—	
			94	

Survey of the author's material.

	Non toxic	Toxic	Basedow's triad
Nodular goitre (Conglomerate goitre)			
parenchymatous (microfollicular) . . .		4	
colloid (macrofollicular) . . .	1	1	
macro- and micro-follicular	1	3	
Nodular goitre (Solitary adenoma)			
parenchymatous (microfollicular) . . .	2	1	
colloid (macrofollicular) . . .	4		
trabecular	1		
macro- and micro-follicular	3	1	
Diffuse goitre			
basedowian		83	58
colloid (macrofollicular)	7		
Acute thyroiditis	1		
Subacute thyroiditis	1		
Cirrhosis of the thyroid	3		
Carcinoma of the thyroid (Papilliferous) .	1	1	
	25	94	58/119

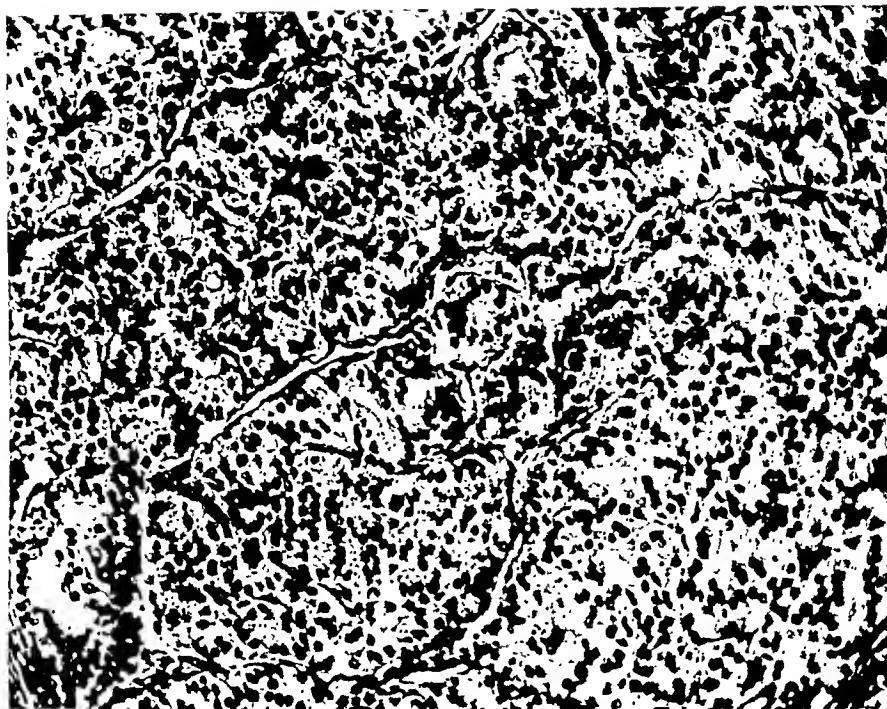


Fig. 1. Non-iodine-treated exophthalmic goitre. Type 1.
Microphoto. Magnif. $\times 200$.



Fig. 2. Non-iodine-treated exophthalmic goitre. Type 2.
Microphoto. Magnif. $\times 200$.

HERTZ: On Thyrotoxicosis.

and associated with thyrotoxicosis due to the adenoma itself, the criterion being that the thyrotoxicosis is cured when the adenoma is removed by enucleation. This conception, which corresponds closely to the opinion of the Americans BOOTHBY-MEANS-PLUMMER-WILSON, is advanced here in Scandinavia by the great Norwegian JOHAN HOLST, but, strangely enough, seems as yet but to cause confusion.

Pathology.

The histo-pathological picture of the thyrotoxicosis shows typical changes consisting in a reduction of the colloid content together with an increase in the parenchyma. As suggested by the American RIENHOFF and the Swedish surgeon TROELL it is possible in the highly polymorphous picture of the exophthalmic goitre to differentiate between a microfollicular and a macrofollicular type. After further histological investigations the author is able to confirm and further these results distinguishing between two types, type 1 and type 2. Type 1 (Fig. 1) signifies the microfollicular form, the massive proliferation of epithelium, corresponding to EWING's "miliary adenomas" and to WÖLFLE's "foetallobuli" which are also found in the normal thyroid glands.

Type 2 (Fig. 2) covers the macrofollicular proliferation with the big winding follicles and the papilliferous excrescences.

The histo-pathological picture of the nodular cases corresponds closely to that which is here outlined. Most frequently it presents a microfollicular picture differing from the exophthalmic goitre merely in showing larger and more massive streaks of connective tissue that divide the goitre into lobes, thereby giving the appearance characteristic of a conglomerate. KLOSE and HOLST have further shown that the pathological processes in thyrotoxicosis in the most initial stages appear as local processes which later on become diffuse through confluence; and the most recent statistical investigations carried out by the author have shown that the conglomerate goitre is a very early or a late stage of an exophthalmic goitre.

The morphological features of the iodine-treatment of exophthalmic goitre and of conglomerate goitre will — as described by HOLST, PETRÉN, TROELL, TAGE LUND and many others — manifest themselves in an increase of the colloid content and a diminution of the proliferation. The colloid, the size and shape of the follicles and the character of the epithelium are thereby

changed, the gland thus approaching the appearance of a normal thyroid gland. This involution, which corresponds closely to the spontaneous, may have different intensity; it may be — and will most frequently be — incomplete, “hypoinvolution”. It may further be “overcomplete” in certain cases. This “hyperinvolution” causes the formation of great colloid adenomas and cysts, or the colloid may burst the follicles and flow out into the interstitial tissue, extrafollicularly, as described by RIENHOFF, who has made the audacious experiment of investigating seven goitres *before and after the iodine treatment*.

Clinical Symptoms.

The cardiovascular symptoms take a most important place in the variegated collection of symptoms in thyrotoxicosis. As expressed by ISRAEL HOLMGREN “Mann kan sagen, dass die Herzsymptome das Band sind, dass sämtliche zur Basedowgruppe gehörige Fälle nosologisch vereinigt”.

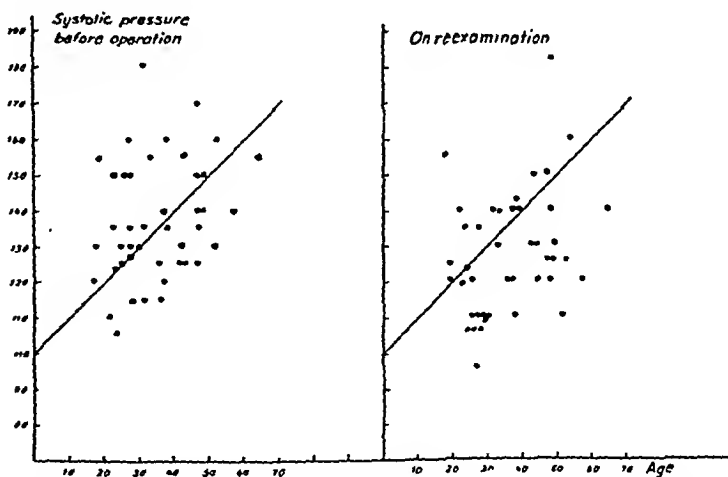


Fig. 3. The relationship between the systolic blood pressure before and after thyroidectomy and the age of the patient.

Already in 1741 TURNER described an increased pulsation of the carotids in these patients, and KOCHER observed a palpable pulsation in the liver and spleen. First recently we have realised, however, that these symptoms are due to the increased amplitude in the blood pressure of the patients with thyrotoxicosis. The author has made investigations over this increased amplitude which has previously been mentioned by the Americans ARNOLD & GIBSON, by the Norwegians HÅKON RASMUSSEN and RÖMCKE, by

the Swedes LILJESTRAND & STENSTRÖM and by the danish surgeon JOHANNES IPSEN. In order to give an impression of the size of the blood pressure amplitude I shall mention, that the average values for the blood pressure of the Mayo-clinic material published by PEMBERTON & WILLIUS shows 147/73 and further that a material published by the danish physician ÅGE TH. B. JACOBSEN shows 143/73. In the author's material the average values for the blood pressure before the operation are 139/66 and 126/74 on

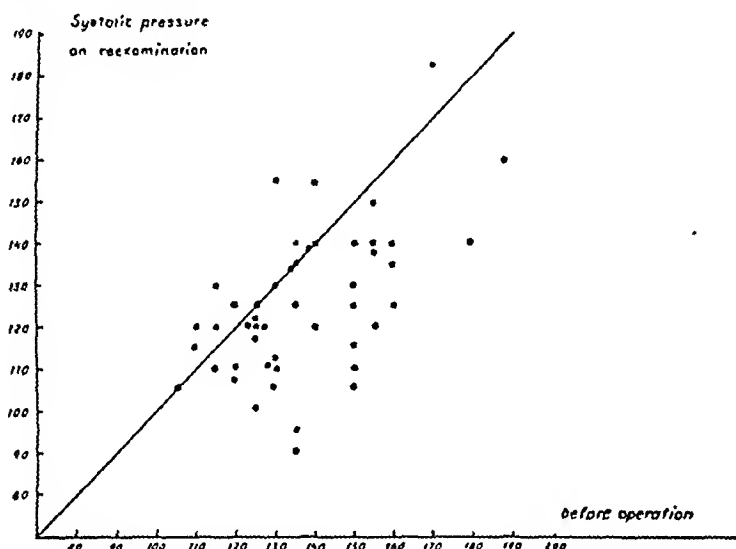


Fig. 4. The relationship between the preoperative and postoperative systolic blood pressure.

reexamination, thus showing a fall in the systolic and an increase in the diastolic blood pressure. The diagrams (Fig. 3—4) show that the systolic blood pressure prior to the operation in about one-half of the cases is higher than the normal maximum for persons in the respective age-classes (The full line). On reexamination the systolic blood pressure has usually decreased somewhat and the excessively high values have fallen to a normal level. It will further be seen that the diastolic blood pressure has increased (Fig. 5). The relation between the systolic and the diastolic blood pressure is plotted in another diagram (Fig. 6—7), so that the full line represents the values with an amplitude of 50 %, that is, cases in which the diastolic blood pressure amounts to one-half of the systolic. Thus the excessively great preoperative amplitude is found to have been reduced considerably as a majority of the cases which before the operation showed an amplitude of 40—70 % at the reexamination show values of 30—50 %.

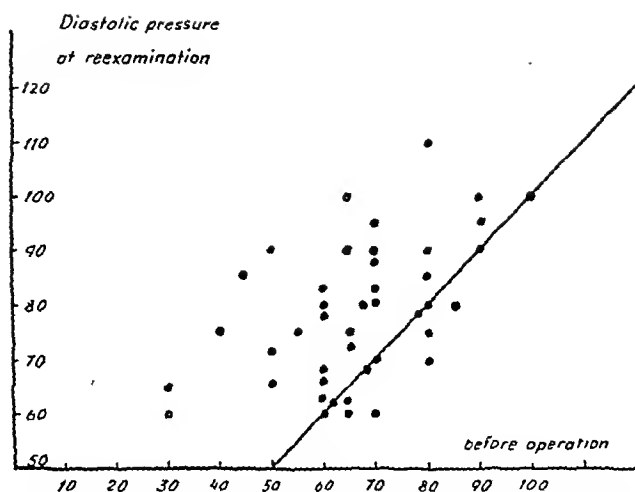


Fig 5. The relationship between the preoperative and postoperative diastolic blood pressure.

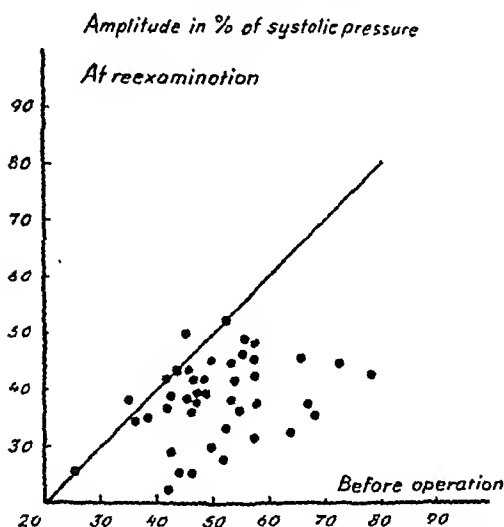


Fig. 6. The relationship between the amplitudes of the blood pressure before and after thyroidectomy.

The increased standard metabolism in thyrotoxicosis calls for an increase in the blood circulation, and it will now be possible to get a definite impression as to whether this rise is due to an increased pulse rate, a rise in the systolic output of the heart, or to both.

It is a well known fact that the pulse rate is increased in cases of thyrotoxicosis. Tachycardia is perhaps the symptom most constantly present in this disease. As shown in diagrams based

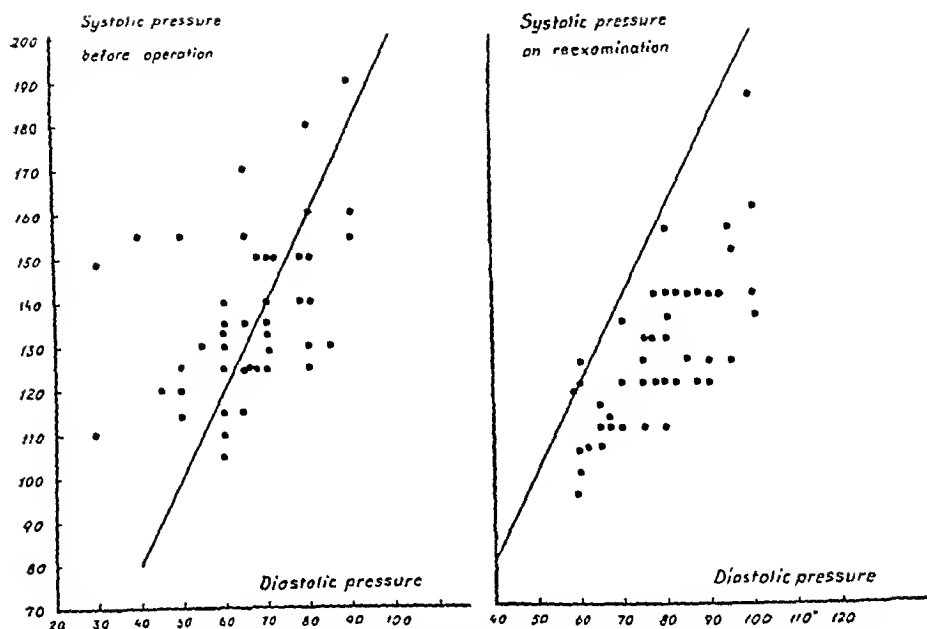


Fig. 7. The relationship between the systolic and diastolic blood pressure before and after thyroidectomy.

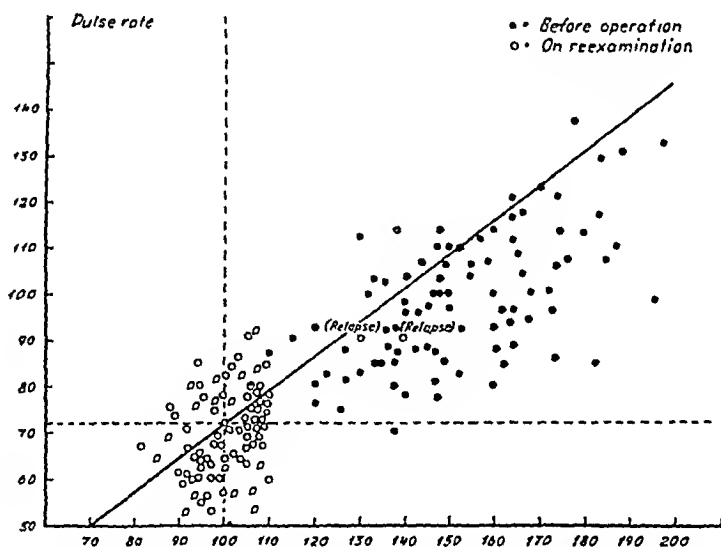


Fig. 8. The relationship between the standard metabolism and the pulse rate in thyrotoxicosis.

on the author's material (Fig. 8—9) the pulse rate is found to increase with increasing standard metabolism, even though this rise is somewhat lower than corresponding to full proportionality (The full line). On reexamination the pulse rate has become normal and so has the standard metabolism.

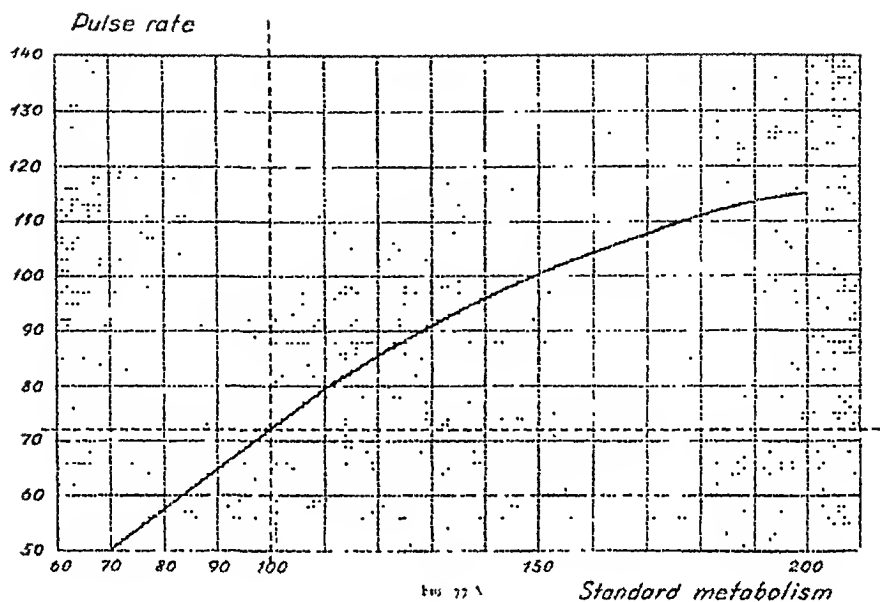


Fig. 9. The relationship between the standard metabolism and the pulse rate in thyrotoxicosis.

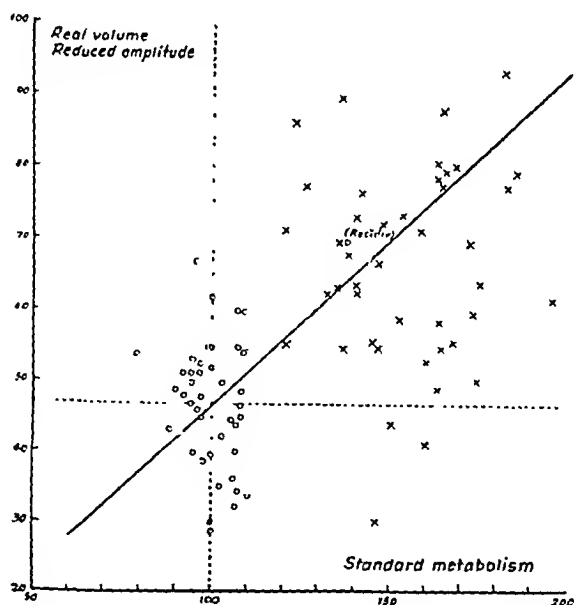


Fig. 10. The relationship between the systolic output of the heart (reduced amplitude) and the standard metabolism in thyrotoxicosis.

Turning to the systolic output of the heart, the Americans FULLERTON & HARROP have found an increase proportional to the standard metabolism. In the author's material (Fig. 10) there is some tendency to a rise in the systolic output of the heart with increasing standard metabolism, but no pronounced correlation exists between the two constants. The systolic output is in this diagram expressed by the reduced amplitude, the values of which normally range round 47 (IPSEN).

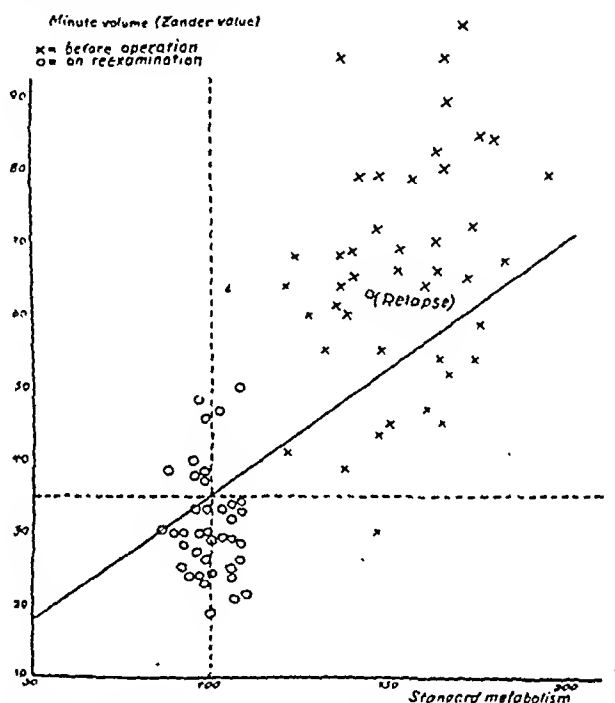


Fig. 11. The relationship between the minute volume ("Zander value") and the standard metabolism in thyrotoxicosis.

The minute volume of the heart must of course be increased. BANSI has found an increase of 80 %, LILJESTRAND & STENSTRÖM have found an increase of 80—100 % in 11 patients with a rise in the standard metabolism of 64—71 %. Expressing the minute volume of the heart by means of the "Zander value" which normally varies round 35 (IPSEN), the author finds (Fig. 11) an increase in the minute volume with increasing standard metabolism. On reexamination the "Zander values" fall to a normal level.

We are consequently — though the reliability of the reduced amplitude and the "Zander value" must be taken with a certain reservation — able to demonstrate that the minute volume in patients with thyrotoxicosis is considerably increased, chiefly

through an acceleration in the pulse rate, but also through an increase in the systolic output of the heart.

As to the question if, in addition, a better utilization of the oxygen of the blood is present, no common opinion has been reached. LILJESTRAND & STENSTRÖM have found an increase in the utilization of 20 %, GLADSTONE has found 37 %, whereas the danish author ESPERSEN has found the utilization alike in patients with thyrotoxicosis and in normal subjects.

I shall not enter into details of the many — most frequently unsuccessful — attempts to map the so called “typical” electrocardiogram of the thyrotoxicosis, but deal only with a few facts in this connection.

It is a well known fact that the thyrotoxicosis may cause an auricular fibrillation. Even the old clinicians (PIERRE MARIE, KOCHER, MURRAY, SCHULZE) observed that arrhythmia occurs with a frequency varying from 4—9 % in exophthalmic goitre and the danish physician L. S. FRIDERICIA found as early as 1916 auricular fibrillation in 6 % of 422 patients with thyrotoxicosis. The most recent larger statistics show *auricular fibrillation to be present in 10—15 % of the cases of thyrotoxicosis*. Auricular fibrillation may — and fairly often does — appear transitorically as noticed by FAHRENKAMP 1914, WARBURG 1929 and by many others. According to ÅGE TH. B. JACOBSEN transient fibrillation is present in 22 % of the cases. “On suspicion of a paroxysmal fibrillation it is the duty of the physician to examine the patient for possible symptoms of thyrotoxicosis” (RÖHMCKE). Less well known — but nevertheless logical — is the fact that an X-ray treatment may cause an auricular fibrillation.

A further study of the P waves may be of some interest. In the literature the P wave has been increased in 25—60 % of the cases of thyrotoxicosis, the increase as a rule occurring in the second lead. In the author's material an increase is only found in 6 %, but this low frequency may be due to the criteria for an increase being so strictly according to the classical description by the Dane ÅSTRUP. According to ÅSTRUP the P wave must exceed 0.12 seconds in width and 0.25 millivolts in height, in order to be designated as increased. It is a very interesting fact that the Frenchman GERAUDEL has seen the P wave in the second lead vary greatly from highly positive to negative in periods synchronous with the dyspnoeic phases in a coincident Cheyne-Stoke's respiration in a case of the very rare syndrom which I have de-

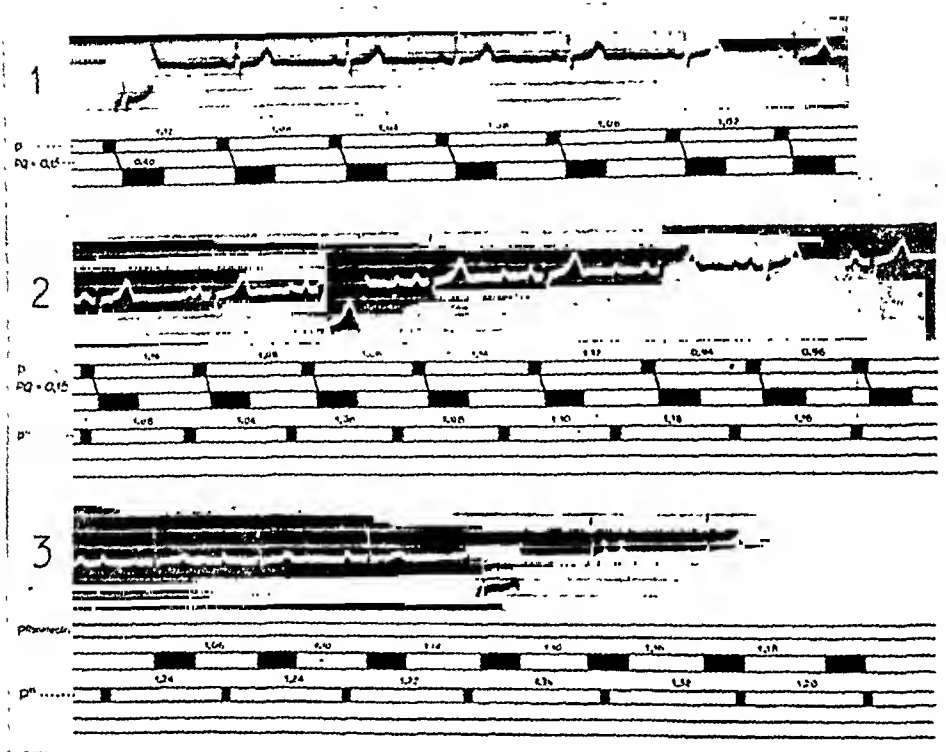


Fig. 12. "Double auricular action with one-sided block."

signated as "double auricular action with onesided block", "Double commande auriculaire" by the French. Only 8 cases-including my own (Fig. 12) — have as yet been literally described. The ground for the study of the electrocardiographic changes in anoxemia has been cleared through brilliant experimental studies carried out by the Dane KAJ LARSEN, who in 18 out of 20 patients, i.e. 90 %, was able to demonstrate an increase in the P wave in the second lead. Even if no exact parallel may be drawn between GERAUDEL's extremely ill patient, the experiments carried out by KAJ LARSEN and the thyrotoxicosis with a compression of the trachea, the idea suggests itself that it would be of interest to see if any correlation exists between an affection of the trachea and the large P wave. The author has consequently made such a tabulation based on his own material. From this tabulation it is evident that the tracheal affection does not persist in any of the (38) patients in whom the trachea was compressed prior to the operation. Further it is shown that a coincidence of tracheal affection and an increased P wave occurs in 6 of the 38 cases, i.e. 16 %. If the trachea is compressed prior to the operation and there is no change in the

P waves (32 cases), no such electrocardiographic change appears on reexamination. In every instance of concurrent affection of the trachea and increased P wave (6 cases), the recovery of the tracheal lesion runs parallel with a disappearance of the anomaly of the P wave. All these facts tell nothing about a direct etiological connection between the increased P waves and the compression of the trachea, but they might give some indications. The author has, however, been fortunate enough to treat — and twice operate — a case which really gives far more reliable and important information concerning the etiological connection between the two components here considered.

Before operation	On reexamination			
	Compression of the trachea and increased P ₂	No compression of the trachea, no increased P ₂	Failed to return	Total
Compression of the trachea and increased P ₂		6		6
Compression of the trachea without increased P ₂		32		32
No compression of the trachea and no increased P ₂	1	43	3	47
	1	81	3	85

The patient was a man, 47 years old, who had a rather severe thyrotoxicosis, the standard metabolism being 171%. He suffered from severe cardiac symptoms and the electrocardiograms showed (Fig. 13) left preponderance, low T₁, diphasic T₂, but no changes in the P waves; the X-ray examination showed no compression of the trachea. He was treated with iodine, during which treatment the T₁ increased and the T₂ became isoelectric. After the preoperative iodization he was operated. On reexamination 2 years after the operation, he showed no clinical symptoms of thyrotoxicosis, but his standard metabolism was 144%. Consequently, he had a relapse of the type which HOLST has designated as "latent thyrotoxicosis"; especially no cardiac symptoms were present and the electrocardiograms were normal apart from left preponderance and an increased P₂. The X-ray examination now showed a considerable compression of the trachea. After a renewed iodization and reoperation he was cured. The electrocardiograms now showed a left preponderance but the P waves were found to be normal and the X-ray examination showed no compression of the trachea.

From the above observations I feel it reasonable to conclude *the relatively frequent occurrence of an increased P_2 in thyrotoxicosis to be an expression of the reaction of the heart to a mechanical influence upon the trachea in the form of a compression, a dislocation or perhaps both.*

I shall not enter further into details concerning the electrocardiographic changes, but only mention a few facts. In thyrotoxicosis we may be faced with left preponderance with large S wave in the second lead. We may further meet with changes in the T waves. These changes have been studied by several investigators, ever since HOFFMANN in 1910 as the first called for their attention. In the literature the T waves have been described as increased, small, inverted or even diphasic. Now the opinion has been reached that the changes met with are low, diphasic or, most frequently, inverted T Waves. These changes have been found prior to the operation in 9.4% of the author's material. It is a most remarkable fact that the inversion of the T waves may be transitoric, just as the auricular fibrillation, and that the changes even in this case may occur postoperatively. I shall shortly mention two cases:

A woman, 54 years old, who suffered from a severe thyrotoxicosis with a standard metabolism of 168%, presented before the operation no abnormality in the electrocardiograms other than a large P_2 , a compression of the trachea was present. After a preoperative iodination she was operated, the operation being very bloody and difficult. She suffered extreme shock after the severe ordeal. She recovered, however, and was feeling well on discharge, but now the electrocardiograms showed a left preponderance and isoelectric T_{1-2} . On reexamination she was found to be in good health, the standard metabolism was 97—99%, but the electrocardiogram was unchanged.

In another case, the patient — a woman with a nodular toxic partly endothoracic goitre and a standard metabolism of 147 % — presented no electrocardiographic anomalies before the operation except left preponderance. After the iodine treatment and operation the T_1 was negative and the T_2 low; the left preponderance persisted.

In the former of these two cases permanent changes thus appeared in the T waves immediately after and probably caused by the operation, in the latter transitoric changes occurred.

Occasionally a large Q_3 has been observed in thyrotoxicosis, further increased R waves, and depression in the S—T segment, which the author has observed twice, both cases presenting a normal electrocardiogram after the operation. Finally, extra-

systoles may be met with, in the author's material in 2.1 % of the cases.

The purpose with this statement of the cardio-vascular symptoms is among others to point out that in cases with tachycardia and increased amplitude in the blood pressure we are with prevailing probability faced with thyrotoxicosis; if further transitory auricular fibrillation is present the probability becomes certainty. Further is to emphasize *that the cardio-vascular symptoms, even the auricular fibrillation, do not constitute any contraindication for operation; on the contrary, they strengthen an indication already present.* In this connection I may quote DOUZÉLOT: "ce n'est pas malgré l'insuffisance cardiaque que l'on peut opérer les basedowiens, c'est a cause de l'insuffisance cardiaque elle-même qu'il faut les opérer". It must be admitted that most investigators during recent years have reached this conclusion, I shall only mention the Americans LAHEY, PHILLIP & ANDERSON-MEANS, the Frenchman LIAN, the Finn WAHLBERG, the Norwegian RÖHMCKE, the Swede TROELL and the Dane EGGERT MÖLLER.

The Iodine Treatment.

Ever since PLUMMER's epoch-making publication from 1923, "the new testament of goitre surgery", the iodine treatment has been one of the key-stones in all treatment of thyrotoxicosis. "It is easier to avoid the complications that follow thyroidectomy than it is to control them after they have developed" as is so lucidly and rightly written by the recently deceased pioneer in goitre surgery GEORGE W. CRILE. Numerous of the older surgeons, in Denmark especially SCHALDEMOSE and his school (SÖLLING, FENGER, DJÖRUP, FLEISCHER HANSEN, WINDFELD), realized that these patients stand the operation better if it is performed during a remission, and therefore tried to induce such a remission by rest and confinement to bed. This treatment might last for months — even up to one year or more — during which the surgeons actually awaited a spontaneous remission. The "pium desiderium", however, was to find a method that would allow the surgeon to induce the remission at his wish and under his full control. This was what PLUMMER enabled us to do. The Americans introduced and worked out the method which afterwards was adopted also in the european countries; we flatter ourselves that the Scandinav-

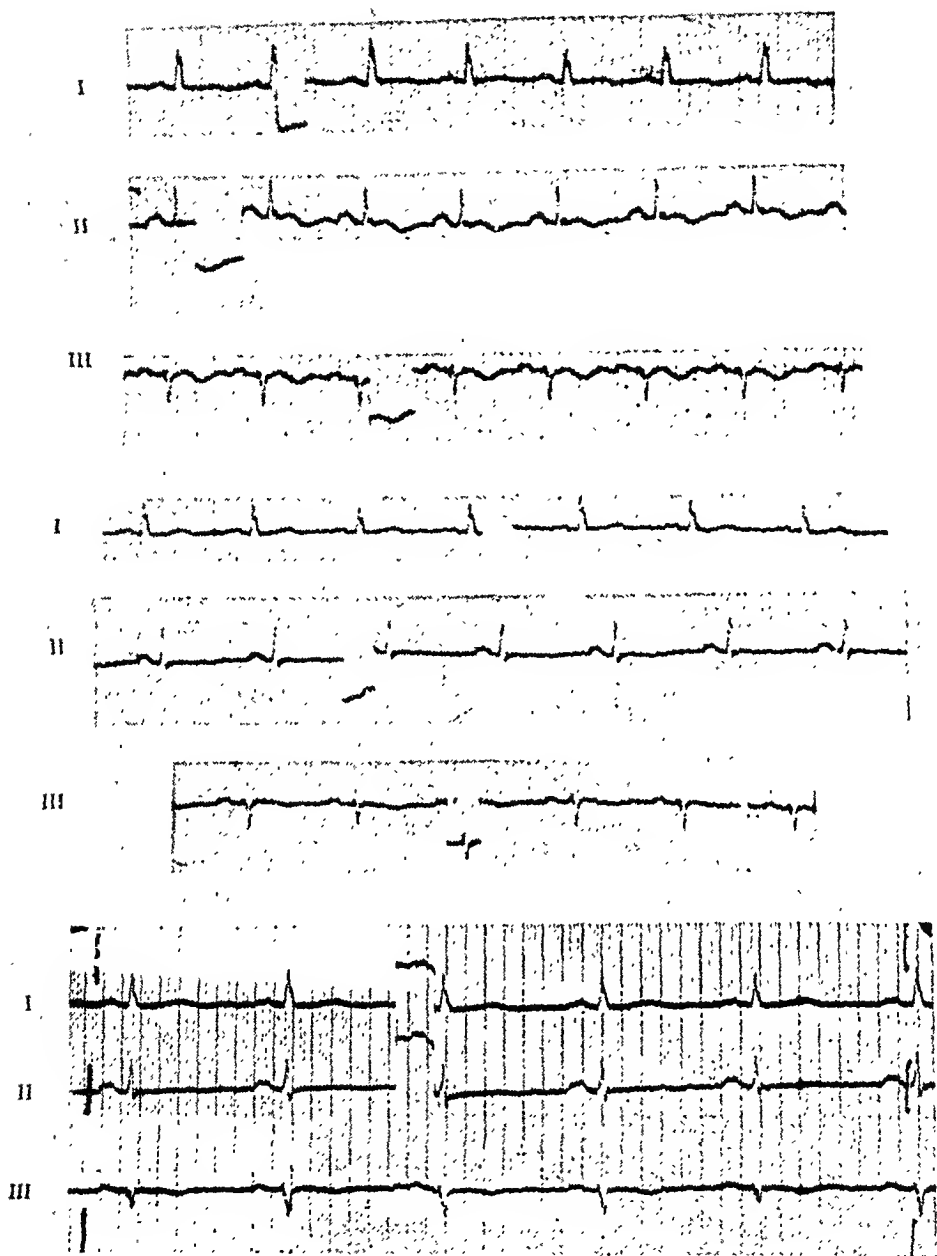


Fig. 13. Electrocardiograms showing changes in the T waves improved by iodination alone. Further, an increased P wave occurring simultaneously with a relapse of the thyrotoxicosis is demonstrated.

Records above, taken the day before the institution of iodine treatment.

Records in the centre, taken the day before the operation.

Records below, taken on reexamination (relapse of thyrotoxicosis).

ian countries were among the first as PLUMMER's preoperative iodination was introduced in Norway and Sweden as early as 1925 by J. NICOLAYSEN and A. TROELL respectively, in 1926 followed J. WAHLBERG in Finland, Denmark fell into the line a little later, in 1928, when FABRICIUS MÖLLER with great discernment and very categorically and rightly formulated the indications for the iodine treatment as follows: "the moment iodine is given, operation is unavoidable if the iodine is effective". I shall not deal further with the indications for the iodine treatment; all investigators now agree to the point of view, that the iodine — with a few exceptions — must be reserved for pre- and post-operative treatment; I shall only from the Scandinavian countries mention names as HOLST, PETRÉN, TROELL, WIJNBLADH, WAHLBERG, EGGERT MÖLLER and from America CRILE, LAHEY, PEMBERTON.

The value of the standard metabolism is used to obtain a reliable numerical expression of the iodine remission and consequently for the effect of the iodine. The questions that arise both in the individual case and generally are: "How much might possibly be obtained?" "When is the proper juncture for the operation?" The importance of operating at the most favourable juncture — and not passing it — cannot be emphasized too strongly. For if this juncture is passed, the patient is brought into a state in which she stands the operation badly, in many cases worse than prior to the iodination. Further, the chances for a renewed iodine remission are lost for a time — even for a fairly short time — a fact that the author himself has had the opportunity to verify (Fig. 14).

In a coordinate system, the standard metabolism just before the institution of the iodine treatment is plotted along the axis of the abscissas, while the standard metabolism just before the operation is plotted as ordinates (Fig. 15—16). As a result of this correlation quite consistent results are obtained. The greatest majority of the cases are seen to fall within a Zone which covers 18—28 % reduction in the standard metabolism, most frequently about 24 %. Converting a great American material reported from Boston by STARR, WALLCOTT, SEGALL & MEANS, so that the calculation becomes the same as here employed, making the results comparable, we find similar values; namely, a reduction amounting to 21—27 %. The author has further plotted the — fortunately very few — cases in which the optimal juncture has been passed in the same coordinate system, the ordinates now representing the

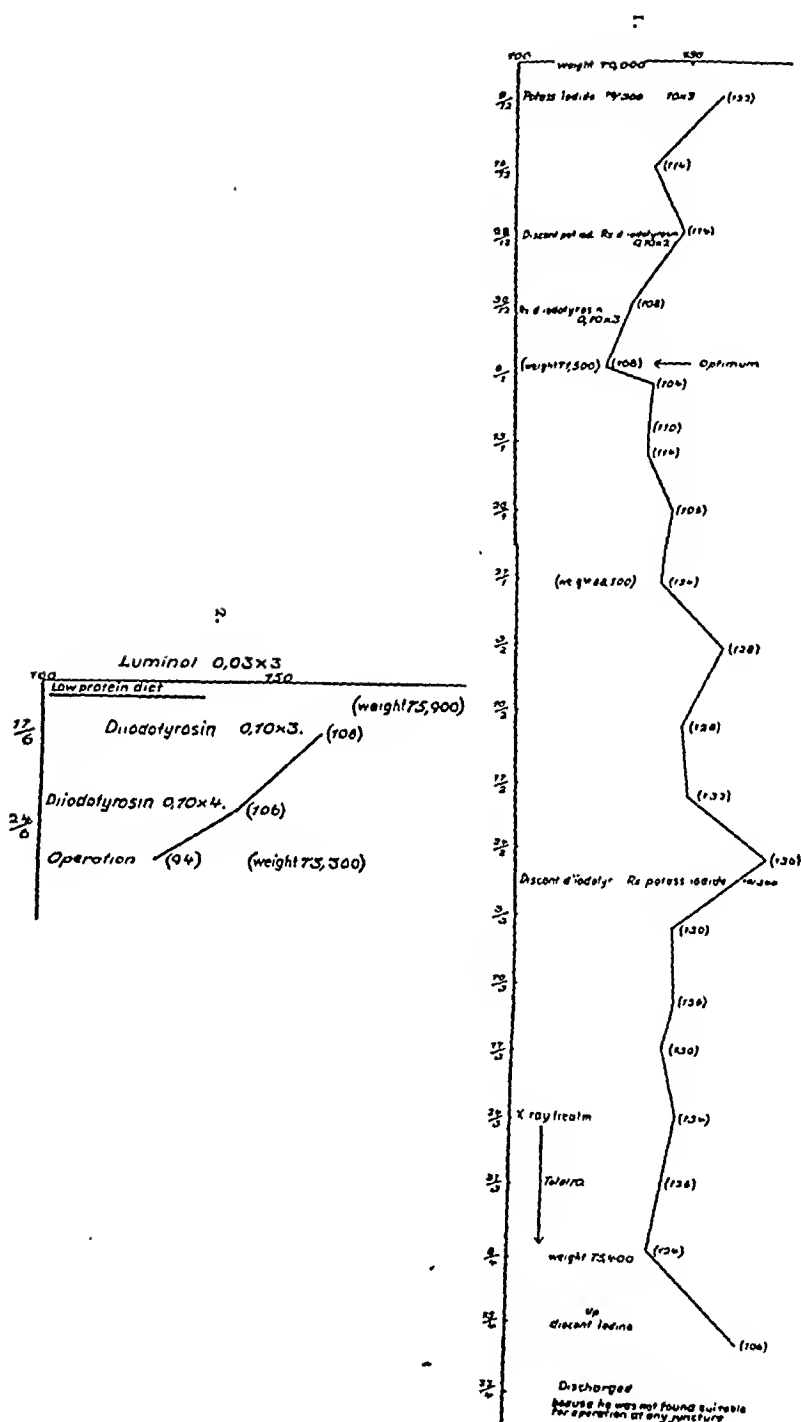


Fig. 14. Standard metabolism curve, illustrating a case in which the optimal juncture for operative treatment was passed once. Finally the patient was operated on and recovered.

standard metabolism at the optimal juncture. These cases, too, fall within the given zone, a fact which must mean that the result most frequently obtained also represents the obtainable; consequently, an answer is given to the above question. *A reduction in the standard metabolism of above 24 %, i.e. $\frac{1}{4}$, must be considered the optimal.* The patients ought thus to be operated when this is obtained and the condition is clinically satisfactory. In the author's material this juncture is most frequently reached on 1—3 weeks.

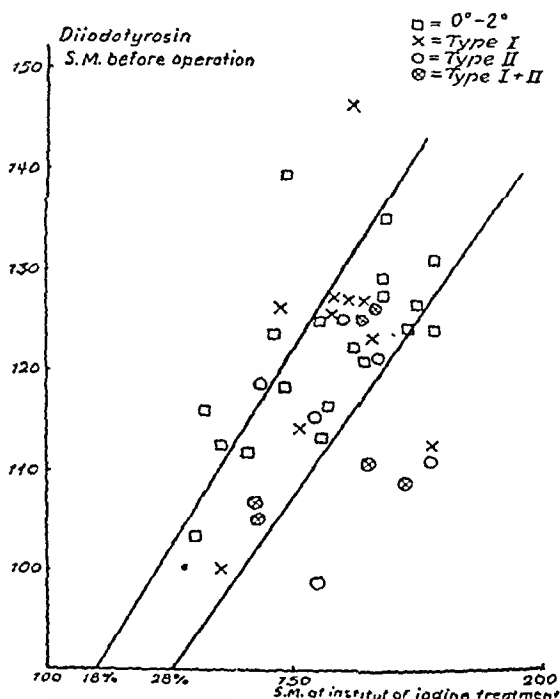


Fig. 15. The result of the preoperative iodization expressed by the reduction in the standard metabolism.

If the iodization should fail — and this happens sometimes notwithstanding every care taken — it is necessary to make a pause for some months and start again. It must be emphasized, however, that the iodization must not be discontinued suddenly as a abrupt halt may be deleterious (BOOTHBY, BAYLEY, WESTERBORN, HOLST). The author has also seen a thyrotoxic crisis arise in this way. On the other hand it has been proved that an iodization does not have any influence upon the reaction of a renewed iodine treatment, when only some time has passed since the previous iodization. This has been mentioned by several in-

investigators (BRENIZER, DAUTREBANDE, EGGERT MÖLLER, PETRÉN, SEGALL & MEANS, STARR & WALLCOTT, THOMPSON & THOMPSON) but their statements have not been given that attention they deserve. The author has plotted the cases from his material in the above mentioned coordinate system and shown that the results thus obtained also are the optimal.

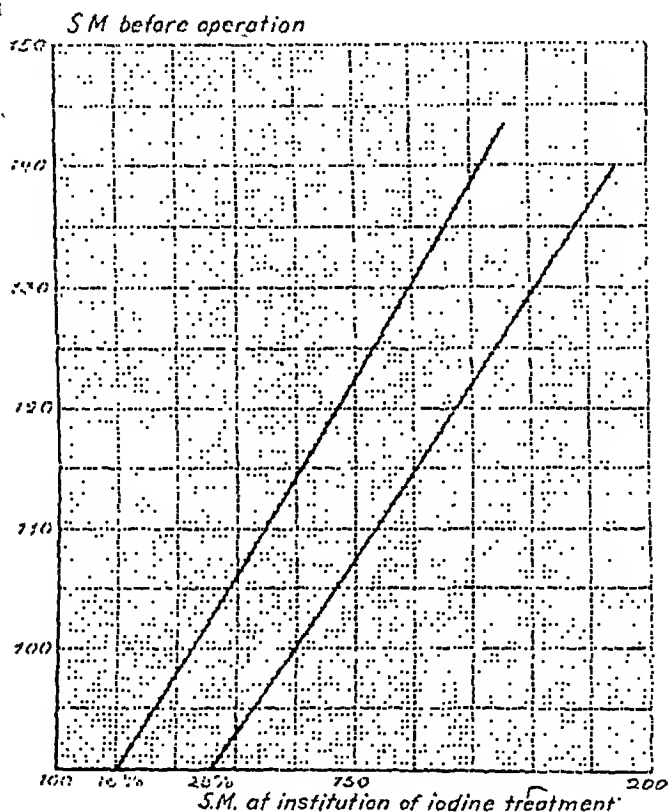


Fig. 16. The result of the preoperative iodination expressed by the reduction in the standard metabolism.

The Low Protein Diet.

On the basis of the experiments carried out by ABELIN, and MEYLER's employment of a very low caloric diet — which cannot be recommended — the author has in collaboration with Professor CARL SONNE, M. D., experimented with supplementing the iodination with a diet almost adequate as to calories — 1,500—2,000 calories daily — but low in protein value — 20 gram protein daily.

The author's material includes 9 patients treated in this way (Fig. 17). In one case (No. 1) the low protein diet was sufficient in itself to produce a rather considerable fall in the standard metabolism. In another case (No. 7) the low protein diet accentuated the reaction already started by the iodine and in this case — as well as in 6 others including 2 most refractory cases — a fine, typical and immediate remission was obtained. Only in one case, a severe relapse, did the combination fail, but finally a state was obtained in which operation could be performed. On plotting

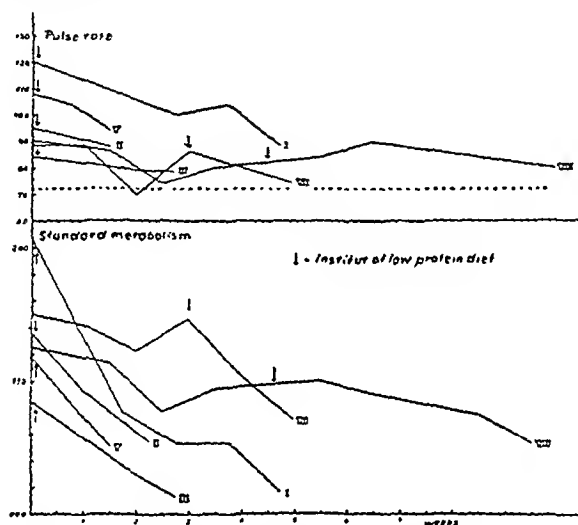


Fig. 17. Cases, illustrating the effect of treatment with diiodotyrosin and low protein diet.

these cases in the above mentioned coordinate system (Fig. 18) the final results in all cases have fallen within the optimal zone, and it seems to me *that the low protein diet in a certain number of cases — refractory cases too — represents a valuable supplement to the iodination.*

An analysis of the refractory cases shows that the cause of this refractoriness has been one of the following three:

1. Iodine treatment shortly before the admission.
2. Inadequate dosage of iodine as emphasised in Sweden by WIJNBLADH.
3. Spontaneous remission shortly before the admission. This is very interesting partly because some of the otherwise apparently refractory cases are explained in this way, partly because it agrees with JOHAN HOLST's theoretical considerations in his fundamental

work from 1928. On account hereof, great care must be shown when an iodine treatment is instituted shortly after or during a spontaneous remission.

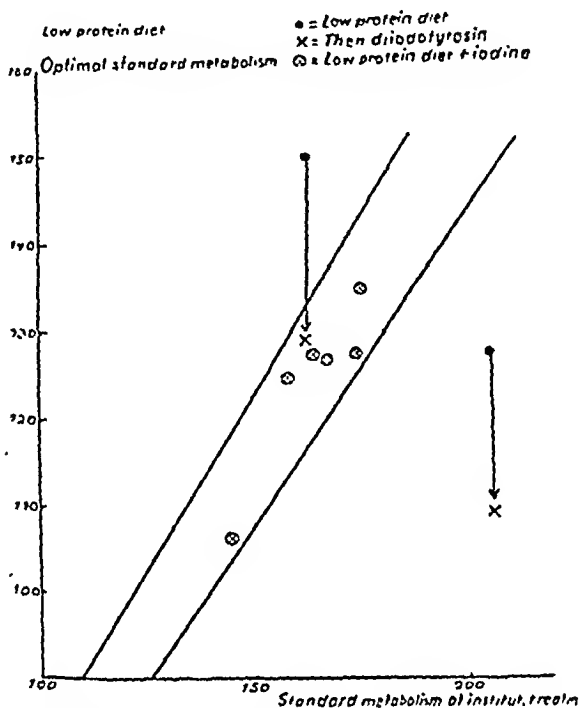


Fig. 18. The effect of the low protein diet.

X-ray Treatment.

In the refractory cases it has been a rather common procedure — and in many places it still is — to try to get a result by means of supplementing the iodination with an X-ray treatment of the thyroid gland. Apart from the results of this procedure being extremely doubtful, it is far from being without risk. Certainly, I shall frankly admit that due to my unwillingness to use this procedure, only 4 patients in the material have been treated in this way, and the failure of the measure may have been due to the selection of these cases as especially refractory. In three cases the X-ray treatment was quite ineffective and in the fourth each application of X-rays had a temporary slight effect. Apart from the lesions dealt with in the somewhat older literature, i.e. oedema of the larynx and necrosis of the larynx which are scarcely met with any longer, the X-ray treatment involves several risks which may be classified in 4 groups. In my fairly minor experience in this field, I have met with all these four groups.

The X-ray treatment may induce a thyrotoxic crisis as described by SCHIÖDTE, GILMER, WIJNBLADH, SECHER, VERNING which even may terminate fatally (RIEDER, SCHIÖDTE, WIJNBLADH). The author himself has observed a patient who after each X-ray treatment suffered from a thyrotoxic crisis. Further, the X-ray treatment may elicit a thyrotoxicosis in cases of atoxic goitre.

The increase in the consistency of the goitre, resulting from the X-ray treatment, may lead to a complete collapse of a severely compressed trachea, thus causing an acute asphyxia. The author has performed a subtotal thyroidectomy and liberated the trachea in a case of this kind in which it was the original intention to make a tracheotomy.

The opinions have been most divided concerning the periglandular adhesions. v. EISELSBERG was the first to call attention to these periglandular adhesions, an observation which was confirmed by other surgeons such as GARRÉ, KOCHER, KRECKE, LEXER, SAUERBRUCH, who spoke strongly against the X-ray treatment especially on account of these adhesions; and the author must admit that his experiences agree with those of the surgeons here mentioned. Such surgeons as DE QUERVAIN — KOCHER's famous pupil and successor — KLOSE-SCHALDEMOSE, however, found no periglandular adhesions after the X-ray treatment. Consequently, both opinions are able to refer to great authorities.

No doubt exists, however, that the dosage of the subsequent resection becomes very uncertain after an X-ray treatment, as emphasized by WAHLBERG and especially by HOLST. A glance in the microscope (Fig. 19) will be sufficient to show the interstitial fibrous thyroiditis as to the extension of which the surgeon may have no beforehand knowledge.

Thyrotoxic Crisis.

I shall not enter further into the question about the thyrotoxic crisis. In WIJNBLAD's home country this would be "to carry coal to Newcastle". WIJNBLADH has elucidated this thyrotoxic crisis, which has also been dealt with by TROELL, GOETSCH, BAYLEY and others. It appears most frequently postoperatively, and then especially in the refractory cases, but it may even be elicited in many other ways. It is with great merit to WIJNBLADH, who emphasized its great value, that treatment by intravenous injection of iodine became general. WIJNBLADH has himself given up to

2.783 mg. daily in such cases. Further, we have learnt from WIJNBADH that a patient suffering from a collapse on the operation table, in most cases may be saved by intravenous application of iodine. According to the author's opinion the greatly overestimated conception "thymic death" should on this account be abandoned.

The Results.

The results of the modern surgical treatment are of far reaching interest. The author's material, dealt with above, includes 94 patients with thyrotoxicosis in a total number of 119 goitre cases. Shortly after the operation as well as by a later — one to three year — reexamination, the patients were submitted to an examination which, besides a thorough clinical examination, includes determination of the standard metabolism, laryngoscopy, electrocardiography, serum calcium, X-ray examination of the heart and the trachea and, in certain cases, examination of the eyes. The demands for the designation "recovery" includes a standard metabolism of 90—110 % and, in addition, normal objective results apart from a onesided paralysis of the recurrent nerve tolerated in one case where no inconvenience to the patient was present. Neither is a total yield of the exophthalmos demanded, as such a demand should be unreasonable with our present knowledge of the pathogenesis of the exophthalmos. The question of the genesis of the exophthalmos calls for further investigations, and the author hopes to be able to approach from a new angle by means of experiments which are only waiting for the necessary material.

The immediate results in the author's material are as follows:

Recovered		85.1 %
Improved	<div> <div>Hypothyroidism 7.4 %</div> <div>Hyperthyroidism 6.4 %</div> <div>Tetany 1.1 %</div> </div>	14.9 %
Dead		0 %

The immediate results, do not, however, tell anything about the final results, which may differ considerably. The final results in the author's material are as follows:

Recovered		91.1 %
Improved	<div> <div>Myxoedema 3.3 %</div> <div>Relapse 3.3 %</div> <div>Tetany 2.2 %</div> </div>	8.9 %
Not reexamined: 4 patients.		

*Comparison between immediate and final results
in the author's material.*

Immediate results	Final results					
	Recovered	Myxoedema	Relapse	Tetany	Not reexamined	Total number
Recovered	93.5 %	2.6 %	2.6 %	1.3 %	4	81
Improved { Hyperthyroidism	85.7 %	14.3 %				7
{ Hypothyroidism	80 %		20 %			5
{ Tetany				100 %		1
Total number	82	3	3	2	4	94

In that four patients have failed to return for reexamination, the comparison between the immediate results and the final shows that 93.5 % of the cases designated as immediately recovered still were recorded as recovered while 2.6 % showed myxoedema — which I have designated as “secondary myxoedema”, 2.6% had a relapse — which I have designated as “true relapse”, and 1.3 % had a postoperative tetany. Among the patients discharged with hypothyroidism 85.7 % had now recovered while 14.3 % still presented myxoedema, “primary myxoedema”. Of the patients who were discharged with hyperthyroidism 80 % had now recovered while 20 % still showed hyperthyroidism, “false relapse”. Consequently, *it is apparent that as well hypo- as hyperthyroidism may change later on with a tendency towards a normal state.* HOLST has explained it by stating that the remaining goitre tissue may proliferate or undergo regressive changes, most frequently the processes counterbalance each other. At an autopsy of previously operated — and now recovered — patients with hyperthyroidism, PEMBERTON has found a normal looking thyroid tissue.

By what means are these strange changes brought about in the remaining tissue during the postoperative period? A division of the author's material in the two histological types, type 1 and type 2, shows (Fig. 20) the cases included in type 1 to present an increase in the standard metabolism, and the true relapses to be found in



Fig. 19. Interstitial thyroiditis (X-ray thyroiditis in exophthalmic goitre).
Microphoto. Magnif. $\times 200$.



Fig. 22. Marked dislocation of the trachea.



Fig. 23. The same patient as in 22
after thyroidectomy.

this group, while type 2 shows no sign of increase and the standard metabolism does not exceed 110 % in any case from this group. Consequently, type 1 must be operated more radically than type 2. Is it beforehand possible to distinguish between type 1 and type 2? Turning again to the diagram over the results of the iodination,

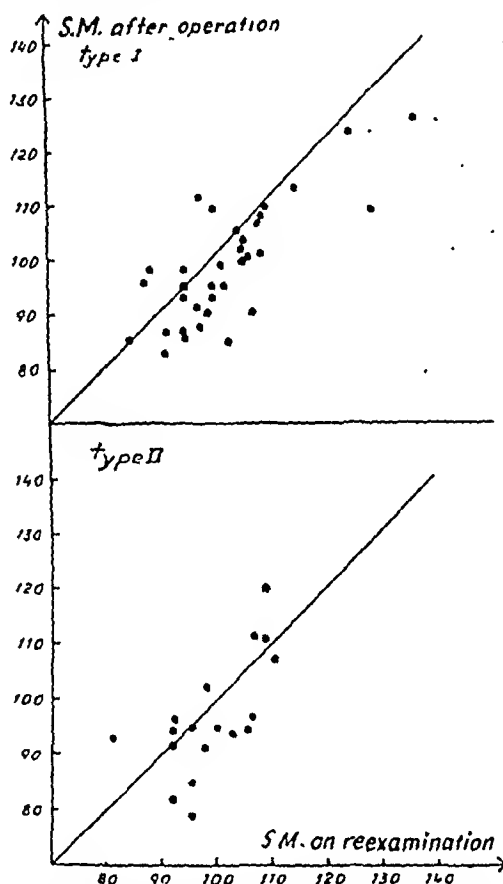


Fig. 20. The standard metabolism after the operation and on reexamination in relationship to the histo-pathological picture. (Types 1 and 2.)

and plotting hereon the histo-pathological types (Fig. 21) we find type 1 to be most common when the reduction in the standard metabolism is too slight (these values fall above the dotted line) whereas type 2 and the other products of involution are met with when the standard metabolism is lowered considerably (the values below the drawn line); the latter is predominant only in a few cases. The diagram shows finally that type 1 is infrequent with a reduction falling between the two lines. The conclusion to this is that the cases which respond only poorly to the preoperative iodination represent those which contain type 1, and should consequently

be operated more radically than the others. It is rather interesting that this account is keeping in harmony with the statements presented by the American LAHEY based upon his enormous experiences (17,388 goitre cases personally operated by him), at the third international goitre conference in Washington 1938. LAHEY emphasized that in the cases which respond poorly to the iodine treatment, "uninvolved cases", it is necessary to perform a very radical resection.

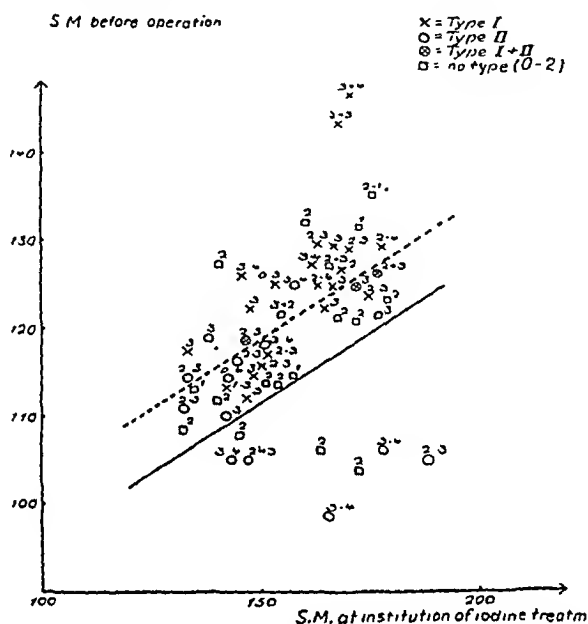


Fig. 21. The effect of the preoperative iodine treatment in relation to the histo-pathological picture.

The Relapses.

The expressions "more radical" and "less radical" must, naturally, not be taken too severely, as the operation has always to be performed radically. It is to a great deal the due of the Danes SÖLLING and FENGER to have shown that the results are the better the more radically the operation is performed. KOCHER has already brought attention to this fact, as in Sweden TROELL, and the excellent results obtained in recent years large American statistics, i.e. CRILE's-PEMBERTON's-LAHEY's above mentioned, have largely been dependant upon this view. In autopsy experiments the author has found that the remnant of the thyroid after a resection corresponding to operations in vivo on an average

amounts to 3 gr. on either side. These figures, however, must be taken only with a grain of salt, as it has to be kept in mind that variations in the congestion of the organs in the living organism will alter the weight considerably. Perhaps this point may be illustrated better by stating that the 3 gr. of the thyroid tissue corresponds to the stone of a small date.

It is hardly possible to overestimate the importance of operating very radically thereby sparing the patient from a reoperation. Based on LAHEY's overwhelming material CATTEL, PERKIN & MORGAN have shown that complications are far more frequent, and often more serious after relapse operations than after primary operations. The tabulation shows the unreasonably great risk incurred by the reoperations even at the hands of a most experienced goitre surgeon.

	Primary operations (4956 cases)	Relapse operations (306 cases)
Relapse	3.3	9.2
Hypothyroidism	4.0	6.2
Postoperative tetany . . .	0.19	2.9
Injury to the recurrent nerve	2.0	14.7
Hemorrhage	0.5	2.6
Tracheotomy	0.1	2.6
Wound infection	1.0	1.6
Mortality	0.67	1.9

After CATTELL, PERKIN & MORGAN.

Even if the operation is performed very radically it is impossible to completely avoid true relapses. The author has operated relapse cases in which the gland tissue to be removed amounted to 70 gr. that is an amount far in excess of what any surgeon would leave even if the operation performed is presumed to be none too radical. The remnant of the gland must have grown out again. On the other hand HAINES & PEMBERTON have reported three cases in which the patients were cured by removal of only 1 — one — gr. thyroid tissue.

I shall not go deeper into operative technical digressions but only — as the question of relapses is mentioned — say that

I employ a special technique during these operations. The author employs the same technique as has been adopted in other fields of surgery, starting from the periphery and working inwards towards the adhesions. This technique has been of good value in a certain number of cases. As the pronounced adhesions are practically always located on the anterior surface of the gland, and towards the trachea, I simply make my way to its posterior surface between the sternocleidomastoid muscle posteriorly, and the pretracheal muscles anteriorly. Having got under the sternocleidomastoid, I penetrate further into the depth below and in front of the omohyoid muscle which is pulled upwards and backwards. In this way the perithyroid, KOCHER's fascie, which is relatively easy recognized, is here reached and divided. Then the pretracheal shield is dissected free from the side which may now be done relatively easily. From now on the operation has to be completed in the typical manner.

Statistics (operated cases).

(The time before PLUMMER.)

	Size of the material	Results in %				
		Mortality	Recovered	Considerably improved	Improved	Unchanged
KINNICUTT (1896)	156	9.9	45.8	35.8		8.0
EHRHARDT (1901)	230	7.4	44.9	23.1	11.1	10.5
BERG & ÅKERMAN (LANDSTRÖM 1907)	52	7.4	48.7	17		26.8
KOCHER (1907)	283	3.5	73.8			
SCHALDEMOSE (SÖLLING 1917)	76	18.4	59.2	14.5		7.9
						very strict criteria

Before PLUMMER's epoch-making publication, a result of 50 % recovery with a mortality rate of 10 % was obtained, as shown by this tabulation based upon statistics from the literature. The best results were obtained by the famous Swiss surgeon KOCHER from Bern who in the "old testament of goitre surgery" from

1907 was able to tell that he had obtained almost 74 % recovered patients with a mortality rate of only 3.5%.

Statistics (operated cases).

(The period after PLUMMER.)

	Size of the material	Results in %						
		Mortality	Recovered	Considerably improved	Improved	Unchanged	Relapse	Myxedema
LIED (BRODERSEN & HARBITZ 1927) . . .	101	0	84.2	—	14.9	0.9	—	—
			71.5					
SCHALDEMOSE (FENGER 1928)	137	5.1	44.6	26.9	13.1	10	—	Too strict criteria
PETRÉN (1931)	436	10.5	—	—	—	—	—	—
Reexamined	300	—	57.3	16.6		10	—	—
GRAHAM & WALLACE (1934)	125	3.2	—	—	—	—	—	—
Reexamined	104	—	63.2	23.7	6.1	0.9	—	—
HOLST (STRÖM 1936)	271	1.3	83	—	—	3	5	—
CHEIVITZ, KJÄRGÅRD & SCHALDEMOSE (WINDFELD 1940)	275	2.9	—	—	—	—	—	—
			90.6					
Reexamined	340	—	48.5	12.2 + 30.6	6	1.8	4.4 false 6.2 true	8.5 Too strict criteria
LJUNGGREN ¹ (1943)	164	1.2	—	—	—	—	—	—
The author (1943)	94	0	85.9	14.1	—	—	—	—
Reexamined	90	—	91.1	8.9	—	—	3.3	3.3

Now after PLUMMER's statement a result of 90% recovered with a mortality risk of less than 1% may be accounted for. In the material published by SCHALDEMOSE and by WINDFELD —

¹ Published at the Swedish Medical Association 7/12 1943.

who is also a pupil of SCHALDEMOSE — I have summed together the cases designated as “recovered” and “considerably improved”, as the requirements for the terms are too heavy. Thus a total yield of the exophthalmos is demanded for the designation “recovered”. This is too strict, being misleading.

Comparative statistics.

	Art of the material	Size of the material	Results in %				
			Mortality	Recovered	Considerably improved	Improved	Unchanged
SCHALDEMOSE & FENGER (1927)	Operation . . .	130	5.4	71.5	13.1		10
	X-ray treatment .	111	7.2	50.4	42.4		
	Medical treatment	60	13.3	43.3	43.3		
DON (1929) . . .	Operation . . .	23	—	73.9	17.1		8.7
	X-ray treatment .	23	—	26.1	21.7	4.4	39
ENGEL (1932) . .	Operation . . .	66	13.6	51.3	21.2		12.1
	X-ray treatment .	28	14.3	57.1	17.7		10.7
	Medical treatment	81	24.7	55.3	9.9		9.9

The statistics comparing the different methods of treatment are published in SCHALDEMOSE & FENGER's classical statement — classical on account of the fanatic sobriety — and in the Englishman DON's statistics, and show with overwhelming clarity the superiority of the operative treatment. The Swede ENGEL, however, is in favour of the X-ray treatment.

The Trachea.

Before finishing the account of the results I shall briefly mention some special problems. The trachea has achieved but meagre attention in the literature, although it is a most important problem in goitre surgery. The few authors who dealt with this question, MARTIN, MONNIER, KÄSTNER, DENK & WINKELBAUR, SGALITZER, have stated that an affection of the trachea recovers in about one-half of the cases, the recovery taking a long time, about half a year. This is not true! In the author's material the trachea was

compressed or dislocated — or both — in 63 cases. On reexamination the trachea was found to be normal in 55, a complete recovery was thus obtained in 91.6 % of the cases as far as the trachea is concerned, and this in most cases already on dismissal. In the rest of the cases, 8.4%, the compression or dislocation had subsided considerable. As an example I shall show a picture of a trachea as it presented itself on admission (Fig. 22) and already shortly after the operation (Fig. 23).

Serumcalcium.

The serumcalcium has in all cases — with two exceptions — in the author's material, postoperatively shown values between 9.1 and 11.6 mg%. The two exceptions (2.2%) show lower values in the one case some time after the operation. In both cases a tetany occurred, albeit relatively mild in the one. The question about serumcalcium and tetany has recently been so thoroughly studied by the Dane LACHMANN that there can be nothing to add.

Paralysis of the Recurrent Nerve.

Concerning the paralysis of the recurrent nerve, CRILE says: "Unilateral abductor paralysis is unfortunate, bilateral abductor paralysis is a tragedy, prevention is the ideal treatment". Fortunately prevention is possible in most cases. In the author's material unilateral paralysis of the recurrent nerve occurred in two cases, 2.1%. In one of these cases the paralysis disappeared spontaneously later on, the reexamination on account hereof presenting altogether 1.1%, a single paralysis.

The fateful significance of the bilateral paralysis of the recurrent nerve is due to the possibility of resulting suffocation.

Indications.

As a conclusion to this account I shall mention the field of indications for the operative treatment in thyrotoxicosis. It is possible to do so shortly and at the same time comprehensively as the thyrotoxicosis with the modern medical and surgical technique represents an almost absolute indication for operative treatment. We have to recognize, however, that, according to the traditions it does not constitute an absolute indication. An almost absolute indication is expressed by ARNOLD & GIBSON in their statement

"hyperthyroidism is always a surgical condition" and by McQUILLAN & BREIDENBACH's "toxic goitre left alone and untreated will kill". The greater majority of the authors — I shall mention at random BOOTHBY, CRILE, MEANS, PLUMMER, HOLST, WIJNBLOED, TROELL, WAHLBERG, EGGERT MÖLLER, FABRICIUS MÖLLER agree in considering the *operation in an iodine remission as the best treatment of the thyrotoxicoses*. This indication is as greatly essential as the contraindications are few and very far from being important. As pointed out by TROELL and HOLST the absence of a palpable goitre does not contraindicate the operative treatment as the goitre may either have a deep or endothoracic location, or it may be of a very modest size — "thyrotoxicose sans goitre" of the French, this occurred in six cases of HOLST's material as published by STRÖM. In the relatively few, very mild cases, in which the possibility of a spontaneous recovery cannot be excluded, it is justifiable to wait, but a progression in the disease must never be tolerated, as in that case "the physician is directly responsible for the misfortune that may arise and, in fact, is bound to arise" as LAHEY puts in forcefully and rightly. In old patients — that means in this connection patients over 65 years of age — the field of indications may be narrowed somewhat, as the operative risk will often be unreasonably great. The Americans CLUTE & SWINTON have stated a mortality rate of 2.06 % in 145 patients in that age class in the hands of an experienced goitre surgeon. Children, on the other hand, appear to stand the operation very well and as the thyrotoxicosis frequently takes a malignant course in children, and they have no chance of recovery without operation, the operation ought to be performed. In addition, the operation in children has to be performed very radically, because the lesion has a great tendency to relapse (WELTI, GOULD & RICHARDSON, HOLST).

With the few exceptions mentioned — age over 65 years, very mild cases under continual observation and slight relapses — *every instance of thyrotoxicosis ought to be treated surgically and no case is too severe for the operation*. The patient who cannot stand the operation is at any rate still less able to stand the disease, her death sentence thus being pronounced beforehand — so why not try to save her anyhow? I shall only mention that symptoms of compression, even if they are only visible by means of X-ray, make the indication for operative treatment absolute, and the operation has to be performed before a malacia of the trachea occurs.

One contraindication for surgical treatment is to be mentioned, however. Great care must be shown during acute aggravations and the operation should not be performed during an acute thyrotoxic crisis but later on, à froid, when the crisis has been brought under control by means of iodine. It is true, however, that KOCHER has operated successfully under such a crisis once — in the case published by ZALIOUK — but this is an experiment that should not be repeated too often.

Summary.

Some problems in the pathology, symptomatology and treatment of thyrotoxicosis are dealt with.

The histo-pathology of the thyrotoxic goitre is briefly mentioned and the two types, type 1 and type 2, are described. The morphologic features of the iodine treatment are also mentioned.

In the symptomatology the blood pressure calls for special attention, the amplitudes between the systolic and the diastolic blood pressure are increased and become normal after the thyroidectomy. Conclusions are drawn concerning the circulatory dynamics in thyrotoxicosis.

Next follows an account of the iodine treatment and the results obtainable, a reduction of 24 % in the standard metabolism considered the optimal result. A diet poor in protein is found to be a good supplementary treatment. Supplementary X-ray treatment is mentioned and considered of no good.

Next follows an account of the results of the operative treatment based on studies in the literature and on a material operated by the author. In this material complete recovery was obtained in 91.1 % of the cases. Conclusions are drawn concerning the relapses, methods to avoid relapses and the technique in operations for relapses.

Finally an account is given of the results obtained in compression of the trachea. The frequency of postoperative tetany and the paralysis of the recurrent nerve is briefly mentioned.

As a conclusion the indications for operative treatment of thyrotoxicosis are outlined.

Zusammenfassung.

Die Histopathologie des thyreotoxischen Kropfes wird kurz erwähnt, wobei seine 2-Typen, Typus 1 und Typus 2, beschrieben

werden. Ferner werden die morphologischen Kennzeichen der Jodbehandlung erwähnt.

Inbezug auf die *Symptomatologie*, wird besonders über das Verhalten des Blutdruckes berichtet, nämlich dass die Amplitude zwischen dem systolischen und dem diastolischen Blutdruck grösser wird, um später nach einer Strumektomie wieder normal zu werden. Verf. zieht auch gewisse Schlüsse inbezug auf die Kreislaufdynamik der Thyreotoxikosen.

Darauf folgt ein Bericht über die *präoperative Jodbehandlung* und die dabei zu erzielenden Ergebnisse, wobei eine Herabsetzung des Grundumsatzes um 24 % als optimal angesehen wird. Eiweiss-arme Diät wird als gute Stützbehandlung angesehen. Auch unterstützende Röntgenbehandlung wird erwähnt, soll aber wertlos und mit nicht geringen Gefahren verbunden sein.

Dann berichtet Verf. über die *Ergebnisse der chirurgischen Behandlung*, sowohl an Hand von Literaturstudien als auch auf der Basis eins von Verf. selbst operierten Materials, in welchem in 91.1 % Heilung erzielt wurde. Es werden gewisse Schlussfolgerungen inbezug auf *Rückfälle* vorgelegt, ferner die Möglichkeit zur Vermeidung von Rezidiven und ein kurzer Bericht über die Technik bei Rezidivoperationen. Schliesslich folgt ein Bericht über die Operationsergebnisse inbezug auf *Kompression der Trachea*, *Tetaniehäufigkeit* und *Rekurrensparesen*.

Als Abschluss wird das *Indikationsgebiet* der operativen Behandlung der Thyreotoxikosen skizziert.

Résumé.

L'auteur reprend brièvement l'histopathologie du goître thyrotoxique puis en décrit les deux types (types 1 et 2). Ensuite il rappelle les signes morphologiques des goîtres traités par l'iode.

En ce qui concerne la *symptomatologie* il s'attache spécialement aux caractères de la pression artérielle chez laquelle l'écart entre la maxima et la minima s'agrandit pour revenir ensuite à la normale après la strumectomie. Il en tire aussi certaines conclusions touchant la dynamique circulatoire des thyrotoxicoses.

Puis il passe au *traitement iodé préopératoire* et aux résultats qu'on en peut obtenir, estimant à ce propos qu'un abaissement de 24 % du métabolisme doit être considéré comme optimum. Il trouve aussi qu'un régime pauvre en protéines est un bon adjuvant au traitement. Il parle également de la thérapeutique

surajoutée par les Rayons Rœntgen mais la considère comme sans valeur et grevée de risques non négligeables.

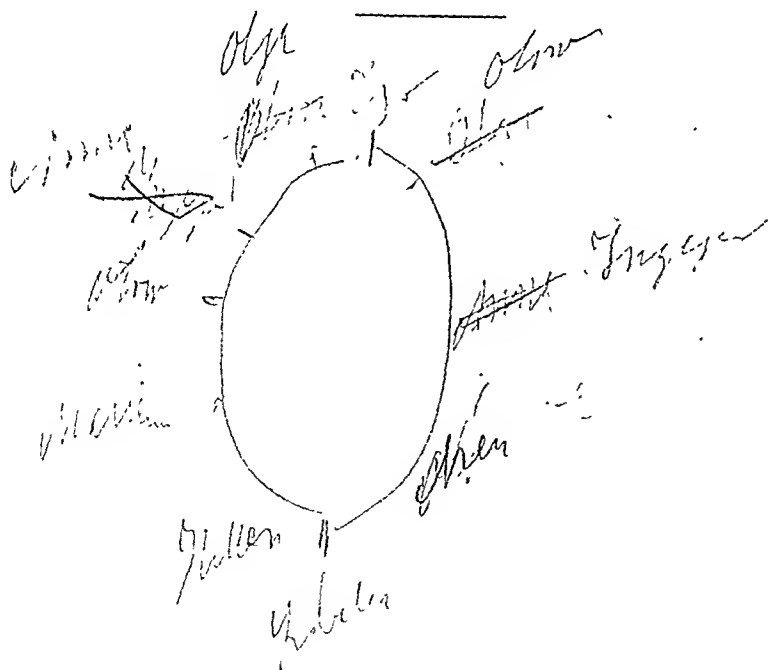
Ensuite il rapporte les *résultats du traitement chirurgical*, soit en se basant sur l'étude de la littérature, soit sur celle du matériel qu'il a opéré lui-même. Dans ce dernier il a obtenu une guérison dans 91.1 % des cas. Il apporte certaines conclusions touchant les *récidives*; il s'occupe aussi de la possibilité de les éviter et traite succinctement de la technique des opérations pour récidives. Puis il rapporte les résultats opératoires en ce qui concerne la *compression de la trachée*, la fréquence de la *tétanie* et les *paralysies du récurrent*.

Pour finir il esquisse les *limites des indications* dans le traitement opératoire des thyrotoxicoses.

Literature.

Concerning *literature* reference is made to:

HERTZ, JOHN: On goitre and allied diseases, especially thyrotoxicosis with particular reference to the surgical treatment. Copenhagen and London 1943.



Contribution à la question de la biopsie avant la radiothérapie du cancer du sein.

(A propos d'une observation.)

Par

ERIK BRATTSTRÖM.

Le cas est celui d'une femme, Mme S. R., 43 ans qui s'adressa d'abord à la Policlinique de la Section Radiologique de l'Hôpital Sahlgren à Gothenbourg, le 31 mai 1935, pour des douleurs du sein gauche. A cette époque, on ne put rien constater de pathologique.

Elle revint cependant trois ans plus tard, se plaignant toujours des mêmes troubles. On put alors palper une tumeur grosse comme une amande dans le sein gauche et elle reçut, pendant les deux périodes allant du 14 au 17 février et du 4 au 8 mars 1938, un traitement radiologique préopératoire de 1,500 r. sur chacun des trois champs habituels — le sein gauche, l'aisselle gauche par devant et le creux sus-claviculaire, l'aisselle gauche par derrière. Filtration par 0.5 mm de Cu + 1 mm d'Al. Distance foyer-peau 40 cm, 185 Kilovolts, 7 Ma.

Puis elle fut envoyée à l'opération qui eut lieu le 14 mars 1938: amputation du sein gauche + curage de l'aisselle (par l'auteur). Evipan + narcose à l'éther. (No de l'observation: 537/1938, IIe Division Chirurgicale).

Diagnostic anatomo-pathologique: on ne peut pas démontrer de restes certains de cancer dans le sein. Aucune métastase ganglionnaire (O. FORSELIUS). La patiente quitta l'hôpital guérie le 27 mars 1938.

Environ deux mois plus tard elle vint à ma consultation pour des tiraillements dans la cicatrice et un défaut de mobilité de l'épaule gauche: des exercices de mobilisation lui furent prescrits là-contre. L'examen du sang, le 23 mai 1938, donna les résultats suivants: Hémoglobine selon Autenrieth 61 %, hématies 3,400,000, globules blancs 7,000, éosinophiles 0 %, basophiles 0.5 %, non segmentés 15.5 %, segmentés 52 %, lymphocytes 32 %.

En dépit du traitement l'épaule s'enraidit de plus en plus et il apparut en outre des douleurs dans le bras; aussi un contrôle radiologique de l'épaule gauche fut-il fait le 30 juin 1938. 3 1/3 mois après l'opération.



Fig. 1.



Fig. 2.

BRATTSTRÖM: Biopsie avant la radiothérapie du cancer du sein.

Réponse: La tête et la moitié supérieure de l'humérus présentent des taches de décalcification. Vu la possibilité de métastases on demande un contrôle dans quelque temps (G. RUNSTRÖM).

En conséquence la malade fut de nouveau hospitalisée dans la Deuxième Division Chirurgicale, du 8 au 23 août 1938.

Status clinique: Les poumons ni le cœur ne présentent rien de particulier. Épaule gauche: Abduction 20°; rotation et autres mouvements articulaires d'étendue tout à fait insignifiante. Forte rétraction de la cicatrice.

Opération: Revision de la cicatrice + biopsie + plastique graisseuse. (L'auteur)

Après «brusement forcé», mobilité complète de la jointure de l'épaule. On incise ensuite le tissu cicatriciel et on rencontre de forts cordons fibreux qui cependant ne donnent pas l'impression d'être cancéreux. On fait une biopsie, puis une libération très étendue des troncs vasculaires et nerveux, et on place un lambeau graisseux prélevé à la région fessière.

L'examen anatomo-pathologique du tissu fibreux excisé n'y montre rien de malin. (FORSELIUS).

Elle sortit guérie le 23 août 1938.

Le nouveau contrôle radiologique qui avait été demandé eut lieu le 19 septembre 1938. Toute la tête humérale gauche présente une décalcification prononcée, et il y a dans la moitié supérieure de l'humérus des raréfactions en forme de taches qui ont nettement augmenté depuis l'examen précédent. On soupçonne des métastases tumorales. (G. R-m).

La malade fut alors réadressée au Service de Radiologie où elle reçut entre le 23 septembre et le 8 décembre 1938, en trois séries, 2,400 r sur le bras gauche par devant et par derrière, ainsi que 1,500 r au niveau du creux sus-claviculaire gauche et autant au niveau de l'aisselle gauche, par devant et par derrière.

Le 6 décembre 1938, nouvelles radiographies: aucune lésion n'est décelable dans la colonne dorso-lombaire, pas plus que dans le bassin, les côtes ni le thorax du reste. L'état du bras gauche n'a pas changé depuis l'examen précédent. (G. R-m).

La malade continuait à se plaindre de douleurs sévères du bras, ainsi que d'un enraidissement croissant de l'articulation de l'épaule, et elle insistait pour qu'on lui désarticulât le bras, ce qu'on lui refusa toutefois.

Réadmise à la Division Chirurgicale on procéda le 20 janvier 1939 à la trépanation de l'os avec prélèvement explorateur. (L'auteur)

Trépanation au tiers supérieur de l'humérus gauche, à la hauteur des porosités signalées par la radiographie. On n'observe rien de cancéreux. Diagnostic anatomo-pathologique: Os nécrosé, avec vacuité des logettes cellulaires. Aucune tumeur n'est rencontrée. (O. FORSELIUS)

Un contrôle radiologique le 23 janvier 1939 montre une perte de substance due à l'opération au milieu de l'humérus, à la hauteur des lésions principales, donc au bon endroit. (G. R-m)

Sortie guérie le 24 janvier 1939.

Elle fut hospitalisée le 2 septembre 1940 à la Division Chirurgicale de l'Hôpital de Hälsingborg (Observation 2056/40).

Les douleurs du bras sont un peu moindres, mais elle doit porter son membre en écharpe, tout contre le corps, car autrement elle a mal dans les articulations du coude et de l'épaule. Elle entre à l'hôpital maintenant à cause d'une difformité croissante, attendu que la région scapulaire gauche est considérablement plus élevée que la droite (saine). De plus, elle désire qu'on lui fasse une arthrodèse du coude afin d'être dispensée de se servir d'une écharpe. Elle se sent en parfaite santé et a augmenté de poids. Cependant elle doit continuellement prendre d'assez fortes doses de pantopon contre les douleurs du bras. Voici un extrait de son status: Bon état général. Le bras gauche est tenu serré contre le corps et il est privé de tous mouvements actifs, ne pouvant être porté ni en abduction, ni en avant. Passivement on ne peut le déplacer que juste assez pour introduire deux doigts entre le coude et la taille; en avant on peut le mobiliser sur environ un centimètre; aucun mouvement de rotation n'est possible. Toute l'épaule est considérablement surélevée par rapport au côté droit, sain; rougeur diffuse, modérée, de toute la moitié inférieure du bras gauche, avec sensibilité diffuse, très forte; le périmètre dépasse de 3 cm celui du bras droit. Le coude est tenu fléchi à angle droit. La mobilité active n'est que de 10° environ dans les deux sens à partir de cette position, la mobilité passive est en tout de 30° approximativement. Tremblement de la main et des doigts, qui diminue la possibilité d'utilisation de la main. La prosupination est réduite de moitié. La force de la main est insignifiante.

Contrôle radiologique du 2 septembre 1940: Image des poumons inchangée, ni là ni dans le squelette il n'y a de métastases visibles. Les géodes du bras ont diminué. (DAHLBERG).

On demanda son avis sur les radiographies au Dr H. HELLMER, maître de conférences à Lund. Il estima qu'elles ne parlaient pas en faveur de métastases au niveau du bras mais bien plutôt d'atrophie par absence de fonction.

Pour diminuer en quelque mesure la surélévation de l'épaule gauche on procéda le 3 septembre 1940 à l'exérèse du nerf spinal gauche (l'auteur). Guérison p. p. A l'exeat; le 9 septembre, l'épaule s'était abaissée d'environ 2 cm. Contre les douleurs on conseilla à la malade comme précédemment une intervention sur le sympathique mais elle réclama derechef une exarticulation du bras, qui lui fut de nouveau refusée.

Là-dessus elle consulta un éminent spécialiste des affections nerveuses chirurgicales qui préconisa une chordotomie contre les douleurs du bras. Le 17 février 1942 elle fut radiographiée à l'Hôpital Sabbatsberg de Stockholm. Le rapport est ainsi conçu: On voit les mêmes modifications que sur les clichés antérieurs de l'Hôpital Sahlgren. De plus il y a un peu d'augmentation des raréfactions en bas du côté externe, de 22 à 24 cm au-dessous de l'extrémité supérieure de l'humérus. Sans nul doute c'est à une tumeur métastatique que l'image ressemble le plus. (M. SIMON) (Figures)

La malade fut réadmise à la Division Chirurgicale de Hålsingborg le 8 février 1943. Excellent état général.

Rapport radiologique: Le bras gauche montre une atrophie osseuse

accrue et une structure vitreuse de l'os, ainsi qu'une augmentation de vacuoles dans la région entre la tête et les épicondyles. Dans la tête il y a surtout de la décalcification. Rien qui parle directement pour des métastases; aucune métastase squelettique par ailleurs. (SCHOLANDER)

A cause des douleurs sévères du bras, et à la demande expresse de la malade, on fit le 5 février 1943 une trépanation avec curettage de l'extrémité inférieure de l'humérus afin de pouvoir poser un diagnostic anatomo-pathologique. (L'auteur) Un contrôle radiologique le 10 février montra que la trépanation avait bien porté sur la région des vacuoles. (NORMAN) Elle sortit guérie le 18 février 1943.

La pièce opératoire fut examinée à l'Institut Pathologique de Lund et le Professeur EINAR SJÖVALL déclara ce qui suit: «On trouve un tissu osseux compact, à surface externe comme interne lisse, et la moelle osseuse est agglomérée en quelques petits pelotons de consistance molle. On dissèque ces derniers et on les examine à part après enrobement. Ils se montrent constitués par de la moelle purement graisseuse, quelque peu hémorragique, et nulle part on ne peut observer d'éléments cancéreux. On décalcifie la substance osseuse compacte, mais à l'examen microscopique pratiqué ensuite on n'y rencontre nulle part non plus quoi que ce soit de cancéreux. Les lamelles osseuses sont bien conservées partout sans trace de structure en mosaïque. Les canaux de Havers sont par place un peu élargis mais sans qu'on y trouve de signes d'augmentation concomitante des cellules.»

Pour résumer ce qui a été rapporté plus haut on peut donc dire ceci: La malade présentait une tumeur grosse comme une amande dans l'un des deux seins lorsqu'elle consulta le Service Radiologique, il y a plus de 5½ ans. On admit que c'était un cancer et on lui administra un traitement préopératoire énergique par les Rayons Roentgen, puis on la fit opérer une semaine après la fin du traitement. Dans la pièce opératoire on ne put déceler au microscope ni restes de cancer, ni métastases. Une radiographie 3½ mois après l'intervention montra des images suspectes de métastases cancéreuses dans le bras gauche, et des contrôles répétés par des spécialistes distingués parlèrent avec une assez grande certitude en faveur de métastases carcinomateuses, alors que quelques autres médecins repoussaient ce diagnostic.

Cependant la biopsie pratiquée au niveau des parties molles sclérosées de l'aisselle, ainsi que des trépanations itératives du bras avec examen microscopique des pièces et rapports d'anatomo-pathologistes éminents, restèrent complètement négatives au point de vue de la malignité.

Il faut spécialement relever que la malade, 5½ ans après l'opération, jouit toujours d'un excellent état général, et aussi que les altérations suspectes qu'on voit sur les radiographies sont tout le temps demeurées cantonnées uniquement dans l'humérus gauche. Les douleurs subsistent; quoique moins intenses elles continuent cependant à nécessiter un traitement au pantopon.

On peut naturellement se demander à bon droit si dès le début le diagnostic de cancer était juste. Vraisemblablement il ne l'était pas. La petite tumeur palpée il y a 5½ ans et traitée par les Rayons Roentgen n'était selon toute vraisemblance qu'une néoformation bénigne. Les doses de Rayons ont dû être trop élevées pour cette malade qui a réagi par une forte sclérose des parties molles. Cette rétraction fibreuse a causé ensuite une diminution de la mobilité de l'épaule, qui a entraîné une immobilisation du bras. L'inaction forcée, à son tour, a occasionné des troubles atrophiques dans le squelette du bras, et sur les radiographies ces altérations se sont manifestées sous la forme de vacuoles qui ont éveillé le soupçon de métastases cancéreuses.

Les violentes douleurs dont la malade s'est plainte tout le temps ont vraisemblablement été causées par la rétraction croissante des parties molles, avec constriction consécutive des nerfs et des vaisseaux dans le creux sous-claviculaire. La tuméfaction oedémateuse de l'avant-bras, qui a existé par périodes, parle sans doute aussi dans ce sens. Mais le tableau clinique n'a pas été celui d'une causalgie pure.

On peut exclure avec une assez grande certitude la lésion opératoire d'un nerf comme cause de l'évolution ultérieure du cas, telle qu'elle a été rapportée ici.

De toute façon il faut malheureusement dire que dans ce cas c'est le traitement qui a estropié la malade. On ne peut pas non plus fermer les yeux devant le fait que cette évolution était probablement évitable. En effet, si avant de commencer toute radiothérapie on avait fait une biopsie (extirpation) de la tumeur suspecte, on aurait très vraisemblablement constaté qu'elle était de nature bénigne, de sorte que toute actinothérapie eût été superflue.

On sait que la question des risques de la biopsie a été souvent discutée. Les circonstances actuelles empêchent d'étudier de façon approfondie la littérature de ces dernières années sur ce sujet, de sorte que je ne puis malheureusement faire état que d'un certain nombre de travaux cités d'après d'autres auteurs, en parti-

culier d'après le professeur ENGELBRETH-HOLM [11], pathologiste danois, qui s'est beaucoup intéressé au problème.

Les adversaires de l'excision exploratrice n'ont pas, que je sache, apporté de preuves véritables de leurs assertions, preuves qui devraient être basées sur des recherches expérimentales ou un matériel clinique comprenant de grandes séries d'observations.

Il y a du reste quelque chose de bien curieux dans l'inconséquence de ceux qui affirment l'existence de ces prétendus risques. On ne trouvera guère de chirurgien ou de radiologue qui hésite devant la biopsie d'une tumeur suspecte du larynx, des bronches, du rectum ou des cavités nasales, sans parler de l'utérus où un curettage explorateur, on le sait, appartient aux examens les plus courants, bien que là plus qu'ailleurs puisse se produire une effraction du système vasculaire favorisant les métastases. Mais quand il s'agit de la biopsie d'une tumeur suspecte d'un sein ou d'un os on estime tout d'un coup qu'il existe un grand risque de propagation des métastases.

La conception courante qui fait d'une irruption éventuelle des cellules d'une tumeur maligne dans les vaisseaux le synonyme de *métastases* est sans doute erronée, d'après les récentes recherches sur le mécanisme des métastases.

C'est un fait reconnu en pathologie infectieuse que même des foyers d'infection banale, localisée, donnent lieu, par intervalles, au passage de bactéries dans les voies sanguines avec développement d'une *bactériémie*, mais sans apparition d'une *septicémie* clinique.

Ainsi nous avons sans aucun doute à compter en pathologie tumorale aussi avec un passage vraisemblablement plus constant de cellules néoplasiques dans le système vasculaire, entraînant une *cellulémie tumorale*, plus ou moins prononcée, et considérablement plus étendue que le nombre des métastases ne le laisserait supposer.

Déjà en 1903 SMIDT a montré que chez des malades atteints de tumeurs malignes on pouvait dans environ 33 % des cas examinés mettre en évidence des cellules néoplasiques isolées, ou des groupes de ces cellules, dans les capillaires pulmonaires — donc des embolies tumorales — (BOYD [7], E. H. [11]).

Lors d'examens post mortem QUENSEL [25] a trouvé chez 50 malades porteurs de tumeurs malignes des cellules néoplasiques dans le sang dans 6 cas, et POOL et DUNLOP en 1934 sur une

série de 40 sujets avec des tumeurs malignes (cancers du sein, de l'estomac, du colon, du rectum et autres) ont démontré 17 fois (donc dans plus de 40 % des cas), des cellules néoplasiques dans le sang (cité d'après E. H. [11]). GORMSEN [15] en 1941 a découvert des cellules tumorales par la ponction sternale chez 14 % de 198 malades atteints de tumeur maligne. Pas moins de 5 % de ces constatations positives concernaient des sujets sans aucun signe, ni radiologique ni clinique, de métastases squelettiques. Il est intéressant de relever que 8 % des cancers du sein où les Rayons Roentgen étaient incapables de démontrer aucune métastase osseuse avaient des cellules néoplasiques dans le produit de la ponction sternale.

Même chez les animaux on a obtenu des résultats semblables. C'est ainsi que JONNESCU a trouvé des cellules tumorales typiques dans le sang de souris sarcomateuses, et que BLUMENTHAL, OSTENFELD et d'autres ont montré qu'on peut avoir des résultats positifs en expérimentant avec des organes, apparemment indemnes de métastases, provenant de souris atteintes de tumeurs malignes. (Cité d'après E. H. [11].)

Cela montre combien étendue et forte est cette dissémination des cellules néoplasiques.

Il est évident, au demeurant, que seule une petite minorité de ces cellules néoplasiques observées dans les vaisseaux donnent lieu à des métastases manifestes, ce qui s'explique entre autres par le fait que la plupart d'entre elles présentent des signes distincts de dégénérescence et ne possèdent donc qu'une faible vitalité.

WOOD et HUNT ont fait des recherches expérimentales sur des rats et des souris porteurs de greffes de *sarcome*, au niveau desquelles ils pratiquèrent des excisions exploratrices tantôt au bistouri et tantôt au galvanocautère. La diversité des techniques de la biopsie n'eut aucune influence sur la fréquence des métastases, par comparaison avec des séries de contrôle adéquates, et MC LEAN et SUGIURA, en 1937, ont pu confirmer ces résultats pour le *cancer* du rat. Des biopsies répétées n'augmentèrent pas le nombre des métastases. (Cité d'après E. H. [11].)

PATERSON et NUTTAL [23] ont examiné 166 malades avec des cancers ayant leur point de départ dans la peau, la muqueuse buccale, etc. Chez 99 on avait fait une excision exploratrice au bistouri et ils présentaient 19 % de métastases. Chez les 67 restants, où aucune biopsie n'avait été pratiquée, on trouva 20.8 %

de métastases. Dans cette série la biopsie n'avait pas favorisé le processus de métastase.

YOUNG a communiqué en 1937 74 cas d'ostéosarcomies ayant survécu plus de cinq ans à l'opération. De ce nombre 25 avaient été soumis à une excision exploratrice avant l'intervention radicale. (Cité d'après E. H. [11].)

Dans le Service du Radium de Copenhague on fait des prélèvements explorateurs de toutes les tumeurs, pratiquement, avant de traiter les malades, et d'après J. NIELSEN [22], E. H. [11] on n'y remarque pas plus de métastases que dans les cliniques où l'on ne fait pas de biopsies. Selon le Professeur L. EDLING [10] les expériences de la Clinique Radiologique de Lund sont similaires.

Le risque de voir la biopsie favoriser les métastases a donc été considérablement exagéré puisque, dans la règle, une quantité de cellules néoplasiques passent spontanément, de toute façon, dans les vaisseaux et que le seul effet nuisible de l'intervention ne consisterait ainsi qu'en une augmentation insignifiante de ces cellules. Mais les recherches citées montrent qu'elles ne donnent pas lieu à un plus grand nombre de métastases.

BOYD [7] écrit au sujet de ces prétendus risques qu'on peut bien se les représenter théoriquement, mais qu'en pratique le danger paraît très petit. Dans les plus grandes cliniques chirurgicales où l'on recourt toujours à la biopsie le pourcentage des métastases, d'après lui, n'est pas non plus supérieur à celui qu'on observe là où l'on s'en abstient. Semblables sont les déclarations de MC GRAW et HARTMANN, EPSTEIN et FEDOREJEFF, PEMBERTON et SMITH, NOVAK, HEALY et KELLY, EWING (cités d'après SWAN [31], SIEMENS [28] et d'autres).

A la Clinique Mayo aussi la pratique de l'excision exploratrice est générale, et dans un article de sa Division Orthopédique sur les tumeurs malignes primitives des os MEYERDING et VALLS [21] écrivent que dans la règle on met largement à nu la tumeur lors de la biopsie, attendu que de la sorte on peut mieux inspecter le néoplasme et faire le prélèvement à un endroit approprié.

Du côté des radiologues, également, plusieurs voix se sont élevées en faveur de la biopsie avant la mise en œuvre du traitement. C'est ainsi que TENOPYR et SILVERMANN [32] en 1941 relèvent que lorsqu'on veut irradier préopératoirement la biopsie est nécessaire, non seulement en vue du diagnostic mais encore pour préciser la variété du cancer, d'où dépendra le dosage. SPACKMAN et HEYNES [29], GARDINI [14] et d'autres se placent

sur un terrain identique. Même au Radiumhem de Stockholm on pratique manifestement des excisions exploratrices dans certains cas. Voir M. STRANDQVIST [30], J. HEYMAN, O. REUTERVALL, ainsi que S. BENNER [16], qui cependant s'en abstiennent avant l'opération du cancer du sein. (E. BERVEN [6].)

Les auteurs qui par principe sont opposés à la biopsie en général font ressortir comme ses inconvénients qu'elle peut entraîner une infection, une hémorragie, une prolifération rapide de la tumeur et un accroissement des cas de métastases. Lorsqu'on fait une biopsie on œuvre une brèche dans la capsule de la tumeur, par laquelle les cellules néoplasiques peuvent se disséminer. (CORREIRO, CATHIE et d'autres, cités par SWAN [31].)

Quant à la biopsie du *cancer du sein* en particulier, elle est déconseillée même par quelques-uns de ceux qui, autrement, sont *en principe* partisans de la méthode.

JANS [18] dit qu'à cause du danger toujours présent de la biopsie il ne faut la faire que si l'examen histologique peut être pratiqué immédiatement, de sorte que l'opération radicale, en cas d'indication, puisse la suivre séance tenante. FEHR et GANZ [12] communiquent 183 cas où l'on a administré le traitement radiologique préopératoire mais sans faire de biopsie attendu qu'à coup sûr elle n'est pas aussi anodine que SIEMENS le prétend. ALLEN [1] nourrit également de grands scrupules à l'endroit de la biopsie et cite KEYNES qui, après y avoir recouru autrefois avant la radiothérapie, y a renoncé parce que lui aussi considère la méthode comme dangereuse, ce que font pareillement PFAHLER, CHEATLE (cités d'après SWAN [31]), SHORE [26] et BERVEN [6].

Cependant ni chiffres ni séries d'observations ne sont apportés à l'appui de cette opinion.

Néanmoins à en juger par la littérature les partisans de la biopsie paraissent même ici former la majorité.

ANSCHÜTZ [2] dit que la biopsie n'assombrit point le pronostic et mentionne 54 cas de la Clinique de Kiel qui n'ont pas évolué plus défavorablement que d'autres, semblables, sans excision exploratrice.

SIEMENS [27] en 1933, a comparé deux séries de la Clinique de Kiel: l'une, de 59 malades atteints de cancer du sein où il s'était écoulé de 10 à 45 jours entre la biopsie faite au bistouri et l'opération; l'autre, équivalente, où l'intervention avait suivi immédiatement le prélèvement. Entre ces deux séries n'existait aucune différence dans la fréquence des métastases.

En 1935 il a présenté [28] une nouvelle statistique de 309 opérations radicales pour cancer du sein du stade I: 60 % de ces malades étaient en vie après 3 ans, 43 % après 5 et 29 % après 10 ans. Sur ces 309 sujets 59 avaient subi une biopsie avant l'opération, et parmi ces derniers 80 % étaient vivants après 3, 70 % après 5 et 62 % après 10 ans. Ces chiffres pour les cas avec biopsie sont donc plus favorables que ceux portant sur l'ensemble du matériel. Mais cela peut aussi être dû à ce que les cas avec biopsie étaient à un stade plus précoce, où le diagnostic était encore douteux. On n'a pu observer ni croissance plus rapide de la tumeur, ni augmentation du nombre des métastases après l'exécution exploratrice.

BAYER [4] à la Maternité de GRAZ et KLOSE [19] à la Clinique Universitaire de Danzig demandent, tout comme SPACKMAN et HEYNES [29] que la biopsie ait lieu aussi précocement que possible dans les cas douteux.

SWAN, HENNINGTON et PARNALL [31] ont fait en 1939 une grande compilation de la littérature anglaise, américaine, allemande et italienne sur ce sujet, où diverses autorités en la matière relèvent les avantages et les inconvénients de la méthode sans apporter de séries de cas. Une petite minorité seulement des auteurs, sont adversaires de la biopsie.

LINDQVIST [20] de la Clinique Chirurgicale d'Upsale a communiqué en 1942 vingt cas de cancer du sein où fut pratiquée une biopsie sans qu'aucune propagation aux ganglions axillaires ne s'en suivît. (Stade I.) Seize d'entre eux (80 %) étaient vivants et sans récurrence au bout de 5 ans. En prenant sur l'ensemble du matériel les 88 cas qui étaient au même stade on trouve 43 survivants sans récurrence (50 %) après 5 ans.

BULL-ENGELSTAD [8] de la Clinique d'Oslo, a rapporté 31 cas, aussi du Stade I, sans biopsie, dont 24 (77 %) vivaient sans récurrence cinq ans plus tard.

PFAHLER et VASTINE [24] ont recommandé en 1934 déjà d'administrer un petit traitement par les Rayons dans tous les cas douteux et de faire ensuite la biopsie; plus tard FRUCHAUD [13] et BECKSTRAND [5] ont conseillé la même chose.

Immédiatement après la suture de l'incision exploratrice BLOODGOOD (cité par SWAN [31]) applique une irradiation profonde, tandis que HRDLÍČKA [17] propose de commencer par l'irradiation proprement dite mais de l'interrompre à mi-chemin pour pratiquer la biopsie.

A ce qu'il paraît l'incision elle-même est manifestement faite au bistouri ordinaire dans la plupart des cas; elle l'est moins souvent à l'électrode diathermique, et plus rarement encore on pratique la biopsie par aspiration. Selon ce qui a été dit plus haut il ne semble pas non plus que le *délai* entre la biopsie et l'opération radicale joue un rôle dans l'augmentation des métastases, ainsi que cela a été relevé par BAUMECKER [3] et montré par SIEMENS [27]. La méthode des coupes par congélation, destinée à obtenir un examen microscopique pendant l'opération elle-même, serait de la sorte superflue. EWING, GREENOUGH, (cités par SWAN [31]) et d'autres mettent aussi en garde contre ce procédé, vu que trop souvent des erreurs ont été commises parce que le pathologiste ne disposait pas d'assez de temps; un examen ultérieur a fréquemment montré que le diagnostic basé sur les coupes par congélation avait été trop précipité.

A propos du cas relaté ici je veux donc, lorsque le diagnostic de cancer du sein est *douteux*, mettre le plus catégoriquement possible en garde contre la tentation de céder devant les prétentions de certains radiologues ennemis de l'excision exploratrice. Je considère au contraire comme condamnable de n'y point recourir. L'excision exploratrice d'une petite tumeur est naturellement synonyme de son extirpation pure et simple, et ce n'est que lorsqu'elle a atteint un volume plus considérable qu'on en fait un prélèvement partiel aux fins d'examen microscopique. De cette façon nous arrivons à une connaissance exacte du caractère malin ou bénin de l'objet que nous traitons véritablement, et nous savons de quelle espèce de néoplasme il s'agit par ailleurs. De plus il en résultera évidemment un accroissement de nos connaissances tant sur les diverses espèces de tumeurs que sur la sensibilité individuelle à la radiothérapie.

Résumé.

L'auteur relate le cas d'une femme qui présentait une tumeur de l'un des seins et qui reçut un traitement préopératoire par les Rayons Roentgen sans que le diagnostic eût été vérifié par biopsie. Après l'opération radicale on ne put démontrer la malignité du processus par l'examen microscopique du sein enlevé. Des altérations qui apparurent plus tard dans l'un des bras furent considérées radiologiquement comme des métastases néoplasiques, mais les examens microscopiques d'excisions exploratrices répétées, pratiquées au niveau de l'humérus, furent incapables d'en prouver

la malignité. Brève revue de la littérature des dernières années sur les risques de la biopsie en général et de celle du cancer du sein en particulier. L'auteur recommande l'excision exploratrice dans cette affection lorsque le diagnostic clinique est douteux, car il n'estime pas qu'on ait apporté de preuves ni scientifiques, ni cliniques, que la méthode augmente le danger de métastase.

Summary.

The author describes a case of tumor of one breast, which was submitted to preoperative roentgen treatment without the diagnosis having been verified by biopsy. Microscopic examination of the diseased breast following mastectomy revealed no signs of malignancy. Later bone changes in one upper arm were diagnosed roentgenologically as tumor metastases, but repeated microscopic examinations of biopsy specimens from the humerus did not disclose malignancy.

A brief review is given of the recent literature on the dangers of biopsy in general and in cancer of the breast in particular.

The author recommends biopsy in the event of an uncertain clinical diagnosis, since he does not consider that any proof, either scientific or clinical, that the method increases the danger of metastasis has yet been advanced.

Zusammenfassung.

Verf. berichtet über einen Fall mit einem Tumor in der einen Brust, der präoperative Röntgenbehandlung erhielt, ohne dass die Diagnose durch Probeexzision bestätigt worden wäre. Nach der Radikaloperation konnte bei der mikroskopischen Untersuchung der abgetragenen Brust keine Malignität nachgewiesen werden. Später auftretende Skelettveränderungen im eine Oberarm wurden röntgenologisch als Geschwulstmetastasen diagnostiziert, aber bei wiederholter mikroskopischer Untersuchung von Probeexzisionen aus dem Humerus konnte man keine Malignität nachweisen. Kurze Übersicht der neueren Literatur über die Gefahren der Probeexzision im allgemeinen und bei Cancer mammae im besonderen. Verf. empfiehlt hier die Probeexzision bei unsicherer klinischer Diagnose, da er nicht der Ansicht ist, dass wissenschaftliche oder klinische Beweise dafür erbracht worden sind, dass die Methode die Gefahr einer Metastasierung steigert.

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From the City-Hospital. The Hague. Holland.

Technique of the Billroth I—Schoemaker Gastrectomy.

By

Dr. J. TEN KATE,

formerly first assistant of Dr. SCHOEMAKER.

Historical.

It is now a good sixty years ago that BILLROTH resected for the first time with success a gastric carcinoma (January 29, 1881). It is true that PÉAN (1879) and RYDYGIER (1880) already performed the same operation, but both patients died soon afterwards. While PÉAN and RYDYGIER anastomosed the duodenum to the gastric stump at the greater curvature, BILLROTH joined it at first at the lesser curvature. Later on he followed the example of PÉAN and RYDYGIER and so by the Billroth I method is generally understood this manner, whereby the duodenum is anastomosed to the gastric stump near the greater curvature, whereas the part at the lesser curvature is closed.

This method of operating soon proved to have certain risks. A large resection was not without danger according to the tension on the sutures. This risk was greatest at the point where three sutures met and so a fatal course was repeatedly seen as the result of a perforation at this notorious "fatal suture angle" (*Jammer-ecke* — corner of sorrow, calamitycorner, as BILLROTH called it).

The method given by BILLROTH in 1885, the so-called Billroth II, had several advantages to the first mentioned. Without danger of tension a large gastrectomy could be performed, whereas the fatal suture angle could be totally avoided.

Therefore, it is easily understood that the Billroth I gastrectomy soon was given up (also at the instigation of BILLROTH himself) and the Billroth II was nearly exclusively practised. The objections to the Billroth I, however, were only technical; so it was to be expected that finally these risks were to be anticipated by improved technique.

That it has still lasted so long before surgeons dared again perform the Billroth I gastrectomy, is according to W. MAYO to be declared by the great influence the word of BILLROTH had on the world of surgeons in the following decennia. In 1923 he (MAYO) wrote:

"Surgeons of this generation have been very largely influenced by the experience of the master surgeon BILLROTH and the prejudices of his time have extended to the present so that the whole force of surgical experience has been to avoid the reunion of the gastric stump to the duodenum. SCHOEMAKER *was the first to free himself entirely from the BILLROTH prejudice*. He recognized fully that the fatal suture angle did not occur under modern technique, and showed that the extensive removal of the lesser curvature of the stomach with sufficient of the pyloric end to accomplish the purpose of the operation would, in a considerable percentage of cases, enable union between the cut end of the stomach and the duodenum."

In his thesis "On the technique of intestinal sutures" (1896), SCHOEMAKER concluded from animal experiments that the simplest method, namely the end to end junction, gave the best results. The mortality of his animals increased with the end to side and side to side anastomoses. Also at the union of intestines with unequal lumens the end to end junction was to be preferred; the wider stoma was partly closed and then connected with the other.

According to these experiments SCHOEMAKER considered the end to end anastomose as entirely safe, also with resection of the stomach. He had no fear of the fatal suture angle, for his experience with the end to end union of bowels of unequal diameter had convinced him that with a good technique this was without any risk. Though a careful technique could avoid the danger of leakage at the fatal suture angle, the second objection to the Billroth I remained undiminished, namely the danger of too much tension of the sutures with large gastrectomies. This changed when in 1911 SCHOEMAKER described the curviform incision of the stomach. A lengthened tubular gastric stump is thus performed by which it is possible to do even subtotal gastrectomies without the least tension and with facility. In literature this method is often called

the SCHMIEDEN "staircase resection"; to us it seems more correct to speak of the modification of the Billroth I after SCHOEMAKER, because VON SCHMIEDEN published his method for the first time in 1922, so eleven years later than SCHOEMAKER.

Principle of Shoemaker Gastrectomy (fig. 1).

With this method resection is performed of the antrum, a great part of the lesser curvature and the beginning of the duodenum, whereas a tube is formed from the part of the stomach near the greater curvature.

This method has several advantages.

1. *It is radical, yet most economical with healthy gastric wall.*

It is well known, that the lesser curvature is the site of many pathological affections. The carcinoma as well as the ulcer prefer to develop in this place and often extend far to the cardia. The mucous membrane of the antrum, which according to many surgeons ought to be entirely taken away with every gastrectomy, is found high at the lesser curvature, whereas along the greater curvature it does not extend so far from the pylorus.

The SCHOEMAKER gastrectomy, which removes the region where antral mucous membrane, ulcers or carcinomata are found, and on the other hand leaves as much as possible of the normal gastric wall at the greater curvature, can therefore be characterized as a radical and at the same time sparing method.

2. *The remaining gastric tube is always long enough to be united to the duodenum without any tension.*

From fig. 1 b it is evident that the distance A—B is certainly not smaller than the straight distance from a to the duodenum. The gastric tube passes namely straight from the foramen oesophageum diaphragmatis to the duodenum and this distance is rather short, anyhow shorter than the length of the gastric tube when it is stretched. We have sometimes measured this distance on a cadaver and found values varying from 8—12 cM.

The blade of the SCHOEMAKER clamp is long 11 cM. and so the distance A—B too; as therefore the distance A—B is as long as the rectilinear distance from oesophagus to the duodenum, it is to be understood that SCHOEMAKER with many hundreds of even subtotal resections never saw great tension on the sutures.

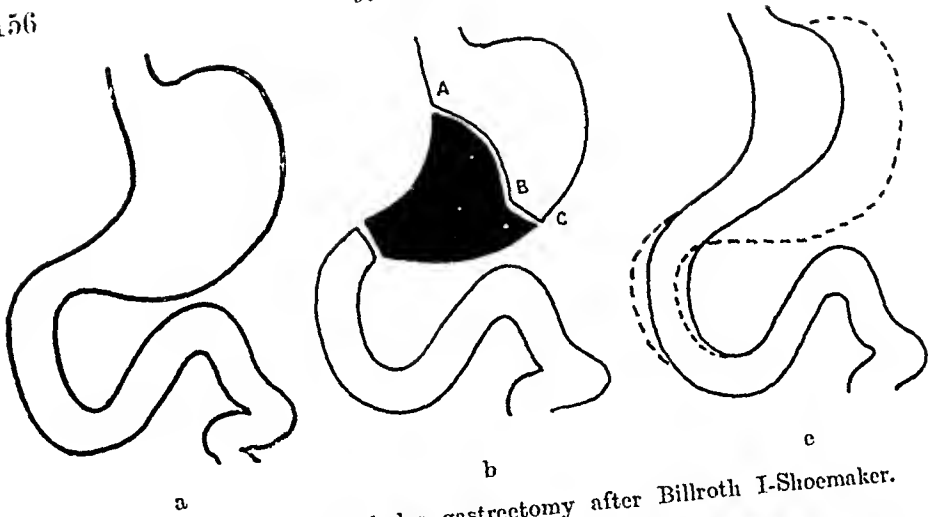


Fig. 1. Sketch of the tubular gastrectomy after Billroth I-Shoemaker.

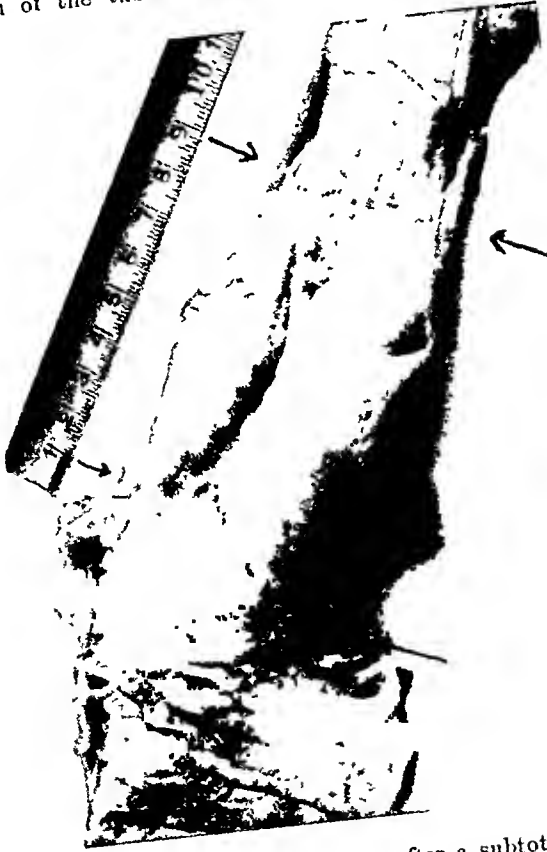


Fig. 2. An autopsy specimen three months after a subtotal Billroth I gastrectomy for a huge gastric sarcoma. The gastric tube was as great as a thumb; yet, the anastomose could be made without the least tension on the suture. The early course after the operation was uneventful. Three months after the operation the patient died by metastases in liver and lungs. The arrows indicate the cardia and the anastomose.

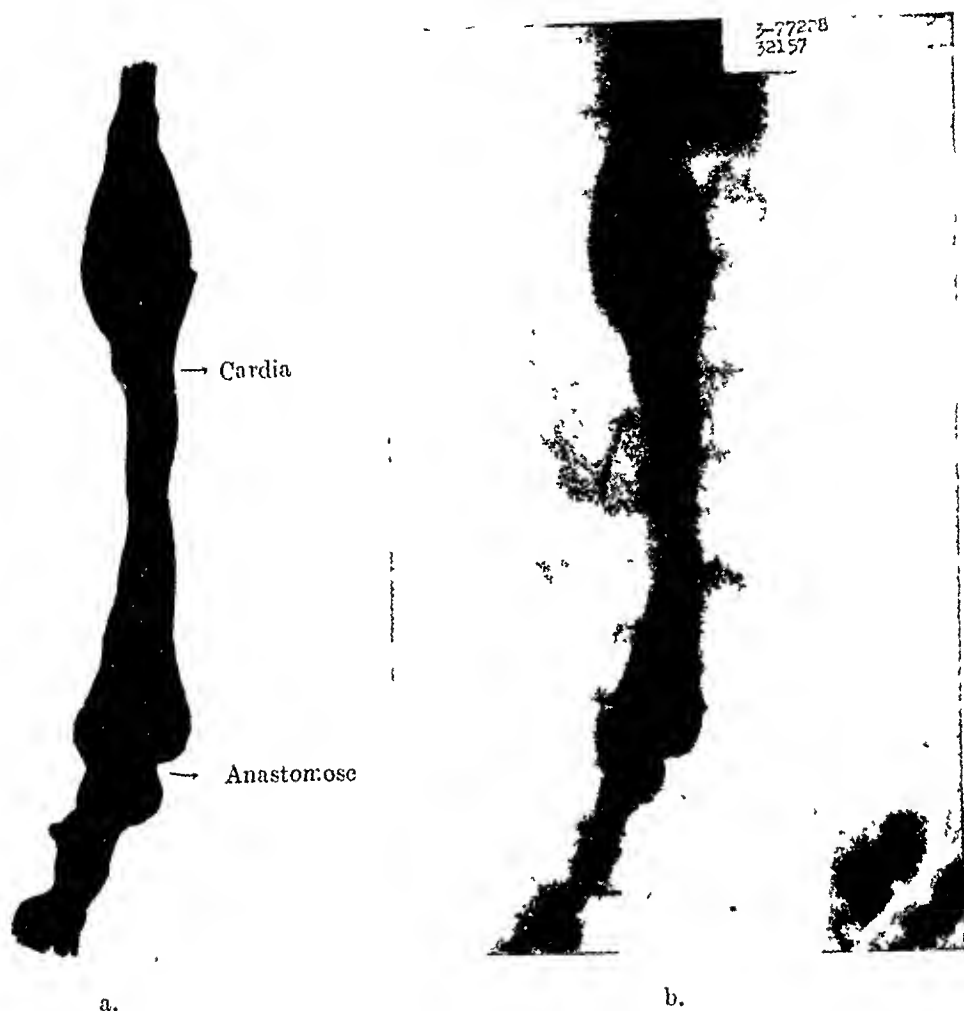


Fig. 3. Roentgenological image of the same stomach as in figure 2. The oesophagus, gastric tube and duodenum form a continuous tube.

In his first description SCHOEMAKER communicated a case, whereby the resection extended as far as 1 cM. from the cardia and a gastric tube of 7(!) cM. could be sutured to the duodenum without tension. After resection of a large sarcoma we could only save a gastric tube of a thumb's length; nevertheless it could be sutured to the duodenum without difficulty. The diameter of this tube was the same as that of the oesophagus and duodenum (fig. 2, 3).

Our own experience is that no gastrectomy can be made so large that a Billroth I should no more be possible!

At the end of his description, SCHOEMAKER remarked that he thought this technique so easy, that he came to apply this method, which at first he only performed with very large resections, with

every gastrectomy. It had namely definite advantages to the Billroth II, as the shorter duration (the duodenum need not to be closed), the facility with which the reestablishment of the gastrointestinal continuity could be secured (by the lengthening of the gastric stump) and the restoring of the *natural* continuity which especially from physiological standpoint cannot be estimated high enough.

In the beginning the curviform incision was made between two curved clamps if there was room enough available above the resection line. If the resection was so large, that proximal of it a clamp could no more be applied, the stomach was pulled down energetically and only a clamp put distal from the resection line. After having made a small incision at the lesser curvature, the gap in the upper part of the stomach was immediately sutured; by the traction there was hardly any leakage from this part. Step by step a same curved incision was now made and at last the first suture line was inverted by a second continuous suture. In 1921 SCHOEMAKER made the curviform twobladed stomach clamp, inspired by the Martel clamp, which served for the closing of the stomach with the Billroth II (fig. 4). The gastrectomy after this method has been performed by SCHOEMAKER and his assistants in thousands of cases and has proved to be without any risks. From 150 own Billroth I gastrectomies for ulcer, we lost 4 patients, so a mortality of 2.7 % (three times a pulmonary complication; in one case peritonitis after resection of a great perforated ulcer at the lesser curvature on a psychotic patient — at autopsy the suture line was good —).

SCHOEMAKER himself never saw a perforation of the suture-line. The performing of a good Billroth I gastrectomy, however, requires a subtle and exact technique and as SCHOEMAKER never described his technique in detail, will in the following be tried to describe the technique into the smallest details, mindful of the word of Michel Angelo: "Trifles make perfection and perfection is no trifle."

The improvement of abdominal surgery is strikingly characterized by BALFOUR with the following words, dedicated to the Billroth I gastrectomy:

"No better example can be found of the advances which have taken place in operations on the stomach and duodenum than the history of this operation, which entailed a prohibitive risk, not because it was wrong in principle, but because of technical faults

in its performance too frequently responsible for death of the patient. The development of better understanding of the principles of anastomosis, particularly more exact knowledge of the type of case in which the operation should be attempted, have made this operation *as safe as any other method of resection* in those cases in which it is warranted."

Description of the Shoemaker Stomach Clamp (fig. 4).

In 1921 SCHOEMAKER gave the following description:

"The clamp must serve two purposes: first, it must grasp the stomach so tightly that the stomach cannot slip when I cut it flush with the clamp; second, the clamp must be so made that it will expose a strip of serosa, which I can suture before I remove the instrument. Therefore, the clamp must be heavy and strong and it must be in two parts."

As regards the first purpose, the objection to most stomach clamps is that with strong pressure the legs at the lesser curvature give way, by which the stomach can slip from the clamp. That this can cause much worry and trouble, is sufficiently known.

The SCHOEMAKER clamp is so constructed that the strongest pressure is not exercised at the greater curvature, but in the middle of the clamp so that slipping of the stomach is impossible.

As appears from the picture (fig. 4), the clamp consists of two parts: an outer and an inner blade. After the clamp has been put on the stomach and the distal part of the stomach has been cut close along the clamp, the outer clamp is removed; the inner clamp now exposes a small strip of seromuscularis by which the first suture is made much easier and an aseptic course is guaranteed (fig. 7).

The outer as well as the inner clamp consists of a blade and a handle. Whereas blade and handle of the former models formed a right angle, the new model has an angle of 135° , by which manipulating in the abdomen is made easier. Both blades have a slight longitudinal concavity, which is necessary for the curviform incision of the stomach. The blade of the inner clamp shows moreover in transversal direction an upwards slightly convex curve, by which the passing of the needle through the strip of seromuscularis becomes easier than would be the case if this blade was a dead level.

The length of the clamp blade amounts to 11 cm.

Besides the big stomach clamp the well known non-crushing intestinal-clamps of SCHOEMAKER are used with this operation. Also with a resection after Billroth II we use as a rule the clamp of SCHOEMAKER. Many surgeons, who never do a Billroth I gastrectomy, but always a Billroth II, use also the SCHOEMAKER clamp. With this instrument one can always resect without any diffi-

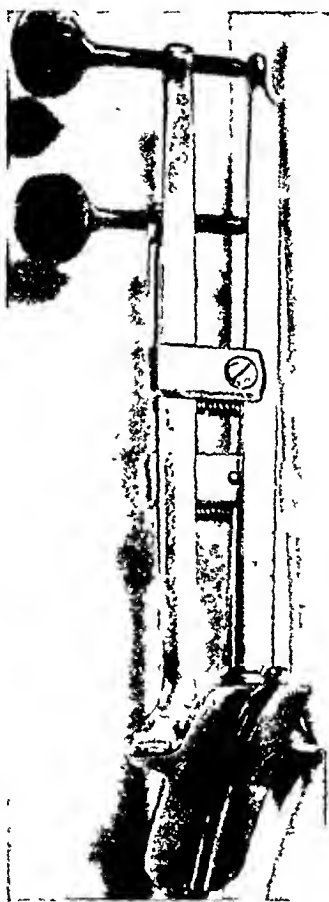


Fig. 4. The Schoemaker gastric clamp.

culty high on the lesser curvature, while the newly formed gastric tube can easily be united to the jejunum (resectio ralis inferior). Especially with subtotal gastrectomies this method has many advantages, because the relatively long gastric tube makes it possible to perform the anastomose at the level of the abdominal wound. With the Polya method a subtotal gastrectomy is much more difficult because the anastomose has to be performed deep below the left costal arch.

Performance of the Operation.

Position of the patient.

At present most operating tables are built in this way that with a laparotomy in the upper abdomen the patient lies horizontally, while with a separate screw the lumbar region can be turned up. The operating table designed by SHOEMAKER made it possible to bring the whole patient in hyperextension, nearly as complete as is used with reposition of vertebral fractures. The advantage of this position is that stomach and biliary ducts are exposed splendidly; for patients, who are operated upon with local anaesthesia, this position however is fatiguing in the long run.

HAROLD DODD, who attended some gastric operations in our clinic, wrote about this position of the patient as follows:

"The position of the patient on the table was a reversed Trendelenburg — that is half sitting up — and this was a considerable advantage in handling the stomach and liver; *I certainly saw more gastrohepatic omentum and liver than in my own operations.*"

Anaesthesia.

One hour before the operation a hypodermic injection of 5 mgr. morphine, $\frac{1}{4}$ mgr. scopolamine and $\frac{1}{4}$ mgr. atropine is given. Besides, a fixed quantity of reetidon, varying to age, sex and weight, is given by the rectum. After this the patient falls quietly asleep on his bed so that he is unconscious of the transport to the operating theatre. In normal cases ether narcosis is now administered. With elderly patients and also with present chronic bronchitis nitrous oxide was given now and then. With bad general condition, local anaesthesia was applied, of late years in combination with evipan intravenous.

Incision.

As a rule, the abdomen is opened by a median incision from the processus xiphoideus to the umbilicus. With patients with a pyenic constitution (broad thorax aperture) and with strong adipositas, the abdomen is opened, when it concerns a duodenal ulcer, by an oblique incision in the right part of the upper abdomen (along the costal arch) which continues to the left costal arch, because the experience learns that ulcers of the duodenum are often to be reached with great difficulty from a median incision with this constitution.

With ulcers near the cardia an oblique incision along the left costal arch was made now and then.

Exploration.

After the opening of the abdomen follows the exploration of the viscera.

It should be pointed out emphatically that a clearly visible ulcer may not be a reason to give up further exploration. On the contrary, also with positive find this is certainly necessary. Not only that next to an ulcer of the duodenum or pylorus another ulcer high at the lesser curvature repeatedly can be found, but also a combination of ulcer and gallbladder disease is not seldom. With 700 operated duodenal ulcers RIVERS and MASON found 118 times an affection of the gallbladder (16.3 %) and with 435 ulcers of the stomach the same in 7.8 %. With women this percentage was yet higher, namely 27 % with duodenal ulcers and 13.3 % with gastric ulcers (according to ALVAREZ).

A disagreeable event showed us the importance of exact exploration. A female patient, with whom a gastrectomy had been performed for ulcer of the duodenum, continued to have attacks of serious pain. After some months laparotomy was performed in an other clinic; the stomach was quite well, but the gallbladder contained stones. After cholecystectomy she had no more complaints.

The mobilization of the stomach.

When a lesion is found which ought to be resected, then the next phase is the mobilizing of that part of the stomach, which will be removed. As a rule this is done in a specific order. The mobilization begins halfway the greater curvature and goes from there to the pylorus; then the duodenum is freed on all sides and not before the duodenum has been cut, the gastrohepatic omentum is separated from the lesser curvature.

The mobilization of the stomach at the greater curvature begins on the spot, where the gastrocolic omentum becomes very thin and where the number of bloodvessels that run to the stomach, decreases suddenly. This is the spot, where according to DEMEL lies the border between the antrum and the fundus. The principal thing in freeing the greater curvature, is carefully avoiding to ligate and cut part of the mesocolon. Especially when the gastrocolic omentum lies close to the mesocolon (by slight adhesions),

we easily fall in this mistake and so we find in literature some cases where the *arteria colica media* was ligated and it sometimes was necessary to perform a resection of the colon. To avoid this complication the best thing is to ligate the gastrocolic omentum close to the stomach (between the greater curvature and the gastroepiploic artery) and to open at once the omental bursa (lesser peritoneal cavity) widely.

The mobilization of the duodenum.

This part of the gastrectomy, which as a rule with a gastric ulcer or cancer can be performed without any difficulty, may cause a lot of trouble when a duodenal ulcer penetrates into the pancreas. CLAIRMONT has justly pointed out that in freeing the duodenum, we have to keep close to the wall in order to avoid damage of pancreatic tissue by which next to other dangers very annoying hemorrhages may occur. There are many small blood-vessels between the capsule of the pancreas and the posterior wall of the duodenum each of which has to be ligated separately; mass ligatures are not allowed. This ought to be done very carefully, lest we take away the serosa of the wall of the intestine. Little ruptures of serosa form no objection to a Billroth I anastomose; several times we have closed small serosa lesions at the posterior wall and performed the resection after Billroth I without ever having seen any drawback. If very tight adhesions are found on one spot, it is sometimes necessary to cut them sharply; if we keep close to the duodenum, the fibrous tissue hardly bleeds. As soon as the ulcer has been passed, at once the freeing becomes much easier and the posterior wall can be loosened far enough to make an end to end anastomose.

With a *duodenal ulcer, which penetrates into the pancreas*, the freeing of the posterior wall asks much time, patience and especially a gentle hand. Technically, it is yet nearly always possible to get beyond the ulcer and to free enough of the posterior wall to allow a Billroth I anastomose, according to the experience of surgeons of great technical skill, as SCHOEMAKER, EXALTO, etc. This does not mean however, that we will generally recommend this method with deep penetrating ulcers. The technique is namely often very difficult and the indication to this method is closely connected with the experience and skill of the surgeon.

When with penetrating ulcers the posterior wall is mobilized, the ulcer will open at a certain moment and bile will escape. This

is without any consequence, but may present the danger that with traction on the stomach the opening in the frail, infiltrated duodenal wall tears more and more. In this cases SCHOEMAKER cut the duodenum through the ulcer whercafter the stomach was folded back to the left. On the posterior wall of the duodenum 4 silk threads were placed as traction sutures to pull at them gently (fig. 9). The forefinger of the left hand was put in the duodenum after which guided by this finger the posterior wall was freed sharply. With the finger in the duodenum we can feel very well, where we can cut without damaging the posterior surface. After having done this over a certain distance, the infiltration as a rule soon decreased and again and again it was surprising to see how we found after this troublesome process healthy duodenal wall, which made a Billroth I possible without any difficulty.

DUVAL describes that with penetrating ulcers, the duodenum beyond the ulcer can often be freed at first; a tunnel is made thus and through this a blunt instrument can be brought behind the duodenum. Once the ulcer is isolated like this, the callous mass can be cut sharply. Sometimes we have been able to mobilize the posterior wall rather easily in this way, but it remains a drawback that in making this tunnel we are to go it blind, so that hemorrhages and injuries of the wall of the duodenum cannot always be avoided.

We conclude that the mobilizing of the posterior duodenal wall is nearly always possible, at least with skilled surgeons, but that the difficulties can be so many that in certain cases of penetrating ulcers a less skilled hand will do wise for his patient's sake to abstain from it and choose a less radical way. Besides, just in these cases the duodenal wall is very infiltrated and inflamed whereby according to our research the chance of recurring ulcers increases.

Mobilization of the descendent part of the duodenum after KOCHER is never necessary with the SCHOEMAKER resection technique, because the stomach always can be brought to the duodenum without difficulty. When the posterior duodenal surface has been freed sufficiently, a non crushing colon clamp of SCHOEMAKER is put on the duodenum and the intestine cut along this. To prevent slipping of the intestine from this clamp, we have a small strip protrude from the clamp and this is not cut away before the posterior serosa suture is knotted and the clamp to be removed. According to v. HABERER an ulcer of the posterior wall gives not always alterations of the serosa and is not always visible

in freeing. To be quite sure that an ulcer will not persist unperceived by which a "false recurrence" should occur, he advises always to open the anterior duodenal wall at first to examine the mucous membrane from the inside and not until then to put on a clamp. Indeed we once discovered an ulcer at the posterior wall, which before had not been noticed, after the opening of the duodenum. At the anterior side of the duodenum just beyond the pylorus was a scar of an ulcer, the posterior wall could easily be freed and did not show the least alteration. After opening the duodenum, we found an ulcer just on the spot where the pancreas began, so that we had to give up a Billroth I resection. A second identical case has been seen lately.

The mobilization of the lesser curvature.

Many years ago (1910) SCHOEMAKER described that the lesser curvature can be freed most easily by first cutting the duodenum. Yet up till now, we often see surgeons, who begin a gastrectomy with freeing the lesser curvature. The drawback is, especially if there are adhesions in this region, that we may cause hemorrhages, which are not easily to be mastered. This becomes quite different if we first cut the duodenum. (Then the stomach can be folded back to the left, so that ligature of the arteria gastrica sinistra offers no more difficulties, because the gastrohepatic omentum can be stretched easily. (Die Gefäße der kleinen Kurvatur bieten sich von selbst zur Ligatur an. SCHOEMAKER, 1911.) Above the corner of the stomach the lesser curvature is taken between thumb and forefinger of the left hand, the forefinger along the posterior side and the thumb along the front. In this way we can exactly fix the border between the stomach and the gastrohepatic omentum. An aneurysm needle is then put in on this spot and the whole gastrohepatic omentum tightly ligated. For safety's sake a double ligature is usually laid because by slipping of a single ligature the stump of the left gastric artery can withdraw till near the cardia and give serious hemorrhages. It is a matter of course that with gastric ulcers which penetrate into the pancreas, the ulcer should first be freed from the pancreas, before the lesser curvature can be mobilized. Here too it is advantageous first to have cut the duodenum. To free the ulcer from the pancreas the stomach is folded back far to the left whereafter the index of the right hand tries to pass behind the ulcer. Then it becomes rather easy to free the ulcer sharp- or bluntly from the pancreas, whereby of course

the ulcer will open. The floor of the ulcer is disinfected with jodine tincture. It is a matter of fact that the freeing of a penetrating gastric ulcer is much easier than that of a penetrating duodenal ulcer.

The application of the stomach clamp.

When the lesser as well as the greater curvature are sufficiently mobilized, the big SCHOEMAKER clamp has to be put on the

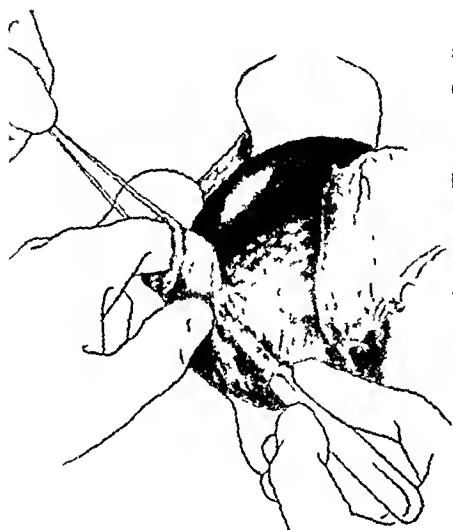


Fig. 5. The mobilization of the posterior duodenal wall with firm adhesions between the duodenum and the pancreas. The left index finger is put into the duodenum; thus, one can exactly feel with sharp freeing where you can cut without damaging the posterior duodenal wall.

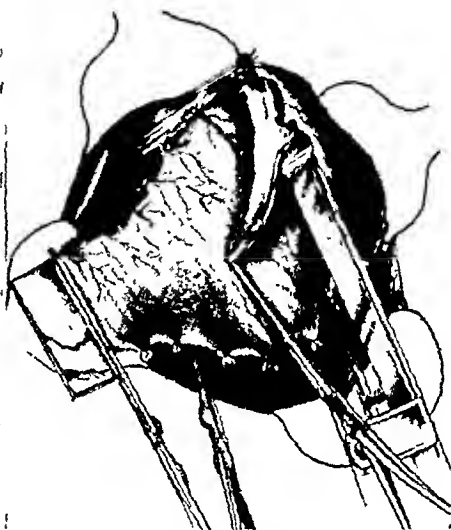


Fig. 6. The Schoemaker clamp is placed on the stomach, the tip projects a little across the lesser curvature. A little colon clamp reaches from the great curvature to the inferior side of the outer blade.

stomach. From several communications I knew that this may give difficulties to them, who have not learned to manipulate this instrument. Therefore, we will describe this in details. The *application of the clamp is always done by the assistant*, because this instrument can be applied easiest from the left. While the surgeon stretches the stomach between both hands, the assistant slips the wide opened clamp from the greater curvature so far across the stomach that the tip projects a little beyond the lesser curvature. The blade lies then with its concave side to the right in accordance with the line A—B from fig. 1 b). In applying the clamp we have to take care that b is about 5 cm. from the greater curvature.

When the clamp is in the desired position, the assistant keeps it thus with his one hand and turns the screw of the outer blade tightly on with the other. Then, the screw of the inner clamp is fastened likewise, so that the stomach is now grasped tightly. Finally a SCHOEMAKER colon clamp is placed from the greater curvature to the part B—C of fig. 1 b), so that the tip of this clamp reaches to the inferior side of the outer blade (fig. 6). Now a non crushing curved clamp is put to the antrum, a gauze is laid below the part that is to be resected, after which the stomach is cut close to the clamp. A small strip of gastric wall is left along the little clamp, just as with the duodenum to prevent premature slipping.

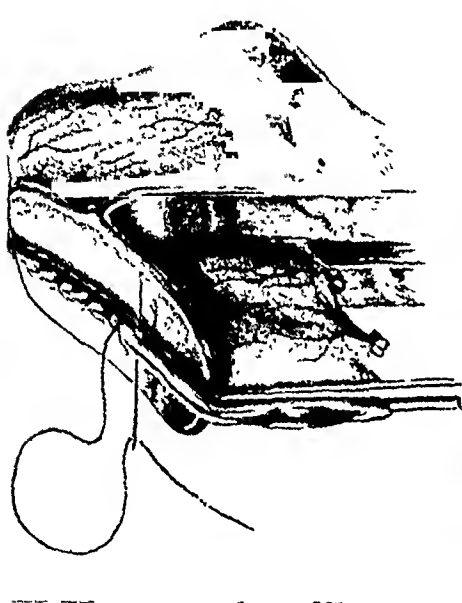


Fig. 7. The outer clamp has been removed; the strip serosa, protruding from the inner blade, is sutured with a continuous catgut thread.

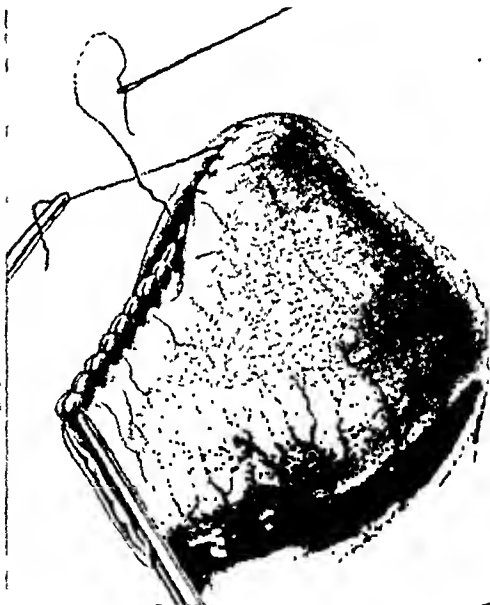


Fig. 8. The inner clamp is removed and a second silk thread is sutured continuously across the first. The upper knot of the catgut thread is pulled down and buried beneath the second thread.

The performance of a new lesser curvature.

After resection of the distal part of the stomach, the outer clamp has to be removed, which is done by completely loosening the screw. The spring of the handle makes the blades give way widely, so that the clamp can be removed easily (fig. 7). Only the inner clamp is then fixed to the gastric clamp; it exposes a serosal strip, which is sutured continuously with catgut (fig. 7). Now the

inner clamp is taken away and a continuous silk suture made across the first. The upper point of the first suture line is pulled down and buried beneath the second, by which a leakage on this point is totally avoided (fig. 8). So the mucous membrane of the stomach is not sutured with this method but crushed by the heavy clamp. We sometimes had the opportunity to examine the inside of the stomach at necropsy; each time we were surprised by the ideal manner in which the non sutured mucosa edges lay together and by the total absence of necrotic parts.

KULENKAMPPF found 6—10 days after gastrectomy with suture of the mucosa next to places, which showed a good healing, others, where the edges gave way and were covered with a nasty, necrotic mass. Had on the other hand, the mucous membrane not been sutured but crushed, then after as many days the place where the edges had been laid together, was hardly to be found and in any case well healed and quite smooth.

Now we have a gastric stump, which has partly been closed in two layers (the new lesser curvature) while the part near the greater curvature, which will be used for the anastomose, is closed by a small clamp (fig. 7).

The performance of the anastomose.

This is an important step of the operation. On the one side care has to be taken that healthy serosa is brought together to prevent leakage especially at the so-called fatal suture angle; on the other hand, we have to be on our guard not to invaginate the serosa too much by which stenose is promoted.

Several writers (v. HABERER, BUDDE) advise emphatically to use interrupted sutures for the anastomose, because a continuous suture offers more danger of stenose. In connection with this it is not without importance that SCHOEMAKER, who as a rule performed a continuous suture up till 1928, sometimes saw a stenose early after the operation in the years before 1928, whereas later on, when on the recommendation of v. HABERER, he only laid interrupted sutures, this occurred no more.

While the assistant brings the two small clamps close together and exposes the posterior surface of the duodenum and the stomach (fig. 9), the operator places first of all a suture at the angles of the lesser and greater curvature through the serosa of the stomach and duodenum. These silk threads are not yet tied but held together in a hemostat. Then the posterior serosa suture

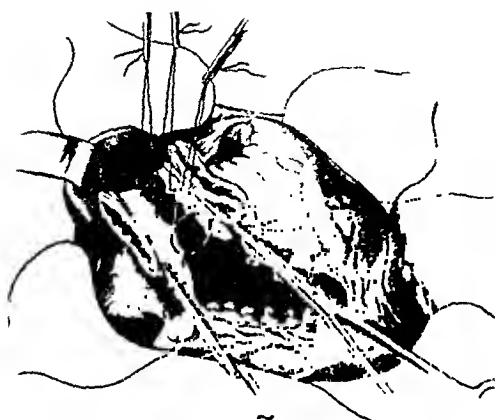


Fig. 9. The posterior serosa suture consists of interrupted sutures, close, to the small clamps. All sutures are laid first before knotting and fixed in a hemostat.

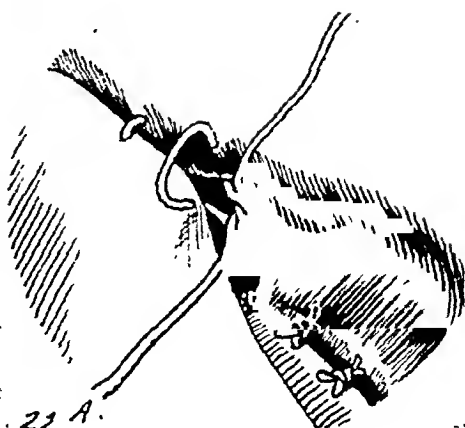


Fig. 10. The anterior three layer suture is made after the method of Mikulicz by which an ideal inversion is obtained. The thread is passed at the stomach from the inside to the outside and at the duodenum from the outside to the inside. Thus the knots come on the inner side.

is made with 6—8 silk threads, which also are fixed in a hemostat to be tied not until all threads are laid. These serosa sutures are inserted close to the clamps so that the knot is not more than half a centimeter from the edge of the clamp. When all threads have been laid, the sutures at the posterior side are tied first and last those at the corners (if the gastric stoma is much wider than the duodenum, a good adaptation is yet to be got if after the tying of the posterior sutures the clamp of the stomach is removed before the corner threads are tied).

The sutures at the posterior side are not cut off but held together in a hemostat, while both corner sutures are each fixed likewise.

SCHOEMAKER immediately cut off the posterior sutures, but it is easier not to do this, because with them we can lift up the anastomose a little, whereby the posterior three layer suture is much facilitated, especially if the duodenum lies deeply.

Before passing on to the posterior three layer suture, the small strip of the stomach, resp. the duodenum, which still protrudes from the clamp, is cut off, whereafter the clamps are removed. With a double sucking tube which does not adhere to the wall, the stomach is emptied by which vomiting immediately after the operation can almost certainly be prevented. A non crushing clamp can now be put higher on the gastric stump, but if the stomach is quite empty, this is not necessary.

The duodenum is now inspected from the inside to be sure, that no ulcer further on is missed and thus to prevent a false recurrence.

While the assistant pulls up the posterior serosa threads, the operator inserts interrupted catgut sutures through all layers of the gastric and duodenal wall, which are immediately tied. As this suture advances, the posterior serosa threads are successively cut off one by one. Finally all catgut threads are cut off except

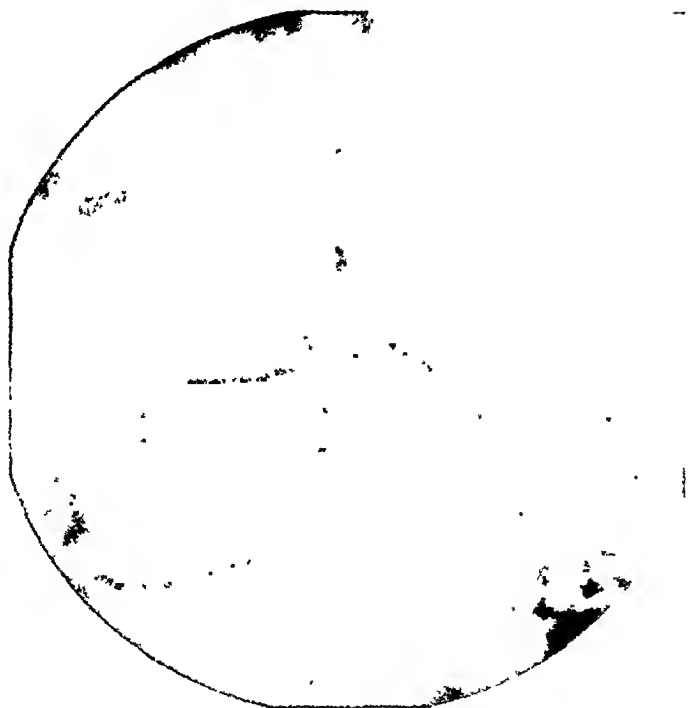


Fig. 11. A nice duodenal bulb after a Billroth I gastrectomy.

the two corner threads. The anterior wall is now sutured in the same way. Here also, not too much should be inverted. half a cM. will do. The threads are laid according the suture method after v. MIKULICZ (fig. 10), whereby all the knots come at the inner side and the wall is automatically inverted. This does mean that seen from the inside, the anterior wall is sutured in the same manner as the posterior wall. The thread is inserted at the stomach from the inside to the outside and at the duodenum from the outside to the inside. Usually was worked from the lesser to the greater curvature. The thread is tied and not cut off; during the knotting of the next thread, the first is pulled horizontally along

the anastomose by which an ideal inversion is obtained. Then the first thread is cut off and so on. With the last suture it was not always possible to lay the knot inward, so that this one was often placed at the outside.

When the anastomose was thus entirely closed, the operator and his assistant changed gloves, clean towels were laid around the wound, whereafter with clean instruments an anterior interrupted serosasure was placed.

Most important is here the care of the point, where the three sutures meet, the notorious fatal suture angle. By help of the corner thread of the posterior serosa suture, the stomach is pulled up a little, after which a suture is inserted, which takes successively the anterior and posterior wall of the new lesser curvature and the duodenum. Thus this point is completely covered by good serosa layers and the surgeons night's rest is no longer imperiled.

MONIHAN called this last suture namely "the slumber stitch". SCHOEMAKER however, convinced that also without this extra suture, no danger was threatening, spoke of the "neurasthenic suture". But in surgery there is no harm in a little neurastheny; we may not forget that the life of a patient may literally hang by "one thread".

If the duodenum was somewhat narrow, we several times successfully sutured the anastomose after NOETZEL. In principle this comes to this that the serosasures, which are usually made after LEMBERT, at the gastric side are performed after CZERNY and only at the duodenum after LEMBERT. With the second suture only the mucous membrane of the stomach is sutured to the whole duodenal wall. So the seromuscularis of the stomach is not inverted, but sutured like a cuff across the anastomose to the serosa of the duodenum. As the thicker part of the stomach wall, the seromuscularis is not inverted with this, the lumen of the anastomose is less narrowed than with the usual method. When the great clamp has been applied to the stomach, a transverse incision is made through the serous coat at the anterior and posterior side of the stomach, according to the line B—C (fig. 1 b) and deepened to the mucosa. The two cut surfaces of the seromuscularis are gently pushed away from the mucosa by means of blunt dissection, after which a little colon clamp is put on the mucosa (fig. 12) and the distal part of the stomach resected along the clamps. Interrupted sutures are now inserted through the posterior margin of the gastric seromuscularis according to CZERNY and through the

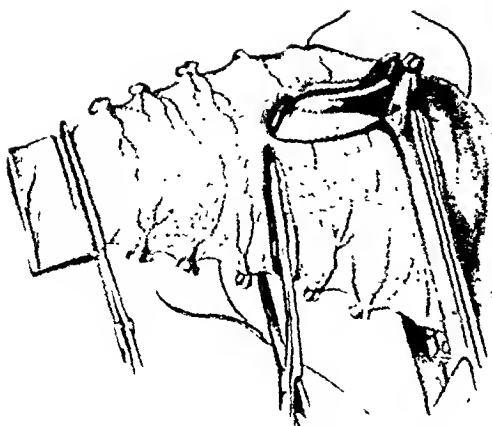


Fig. 12. A Schoemaker colon clamp is placed on the gastric mucosa from the greater curvature to the tip of the stomach clamp.

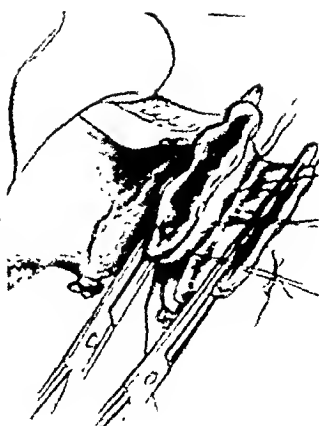


Fig. 13. The posterior seromuscular edge of the stomach is sutured (after CZERNY) to the duodenal wall (after LEMBERT); the knots are tied.

duodenal serosa according to LEMBERT (fig. 13). These sutures need not to be inserted close to the duodenal clamp as in the normal method to avoid stenose; on the contrary, to assure a broad opposition of the surfaces, it is to be recommended to insert the duodenal threads at some distance from the clamp. All layers of the duodenum are now sutured with catgut to the cut edge of the gastric mucosa, first in the region of the posterior (fig. 14), then of the anterior wall. Finally, the anterior seromuscular flap is attacked by sutures applied at its edges (CZERNY) to the anterior wall of the duodenum (LEMBERT), (fig. 15). With this method it is possible to make a wide stoma, even when the duodenum is so narrow, that a finger is hardly admitted. Also with a duodenum that is but moderately narrowed, we have several times sutured *only the anterior wall* in this way, always with good results. The postoperative course was always undisturbed and also with the Roentgenological examination which was performed about twenty days after the operation before the dismissal of the patient, nothing abnormal could be found. The time of evacuation was quite normal.

With this technique we several times made a good anastomose in cases, where otherwise we had no more been able to perform a Billroth I for fear of stenose.

When the anastomose is completed, the width is still once controlled; the stoma is wide enough if the thumb can freely pass.

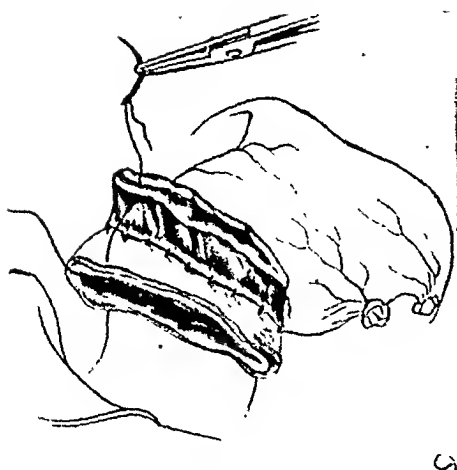


Fig. 14. A second suture with catgut unites the gastric mucosa with the whole duodenal wall.

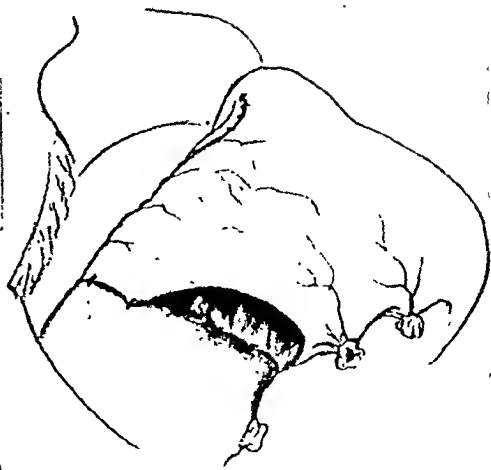


Fig. 15. The anterior seromuscular layer is sutured as a cuff across the anterior wall of the duodenum.

After a last inspection of the operative field, the abdomen is closed in three layers.

The postoperative course is usually undisturbed; vomiting after the operation is only seldom seen.

After 49 Billroth I gastrectomies, we saw only 7 times vomiting after operation; in 2 cases it was necessary to apply a gastric tube.

We have not made it a rule to use a transnasal gastric tube after every gastrectomy; often, it is very disagreeable to the patient and usually it is quite superfluous. Sometimes it is not wholly without danger; lately, IGLAUER and MOLT described necrosis of the laryngeal wall after some days of gastric tubage.

A same opinion is brought forth by D. CHEEVER, when he writes: "I observe the almost routine use of blood transfusions and parenteral fluids as a result of the studies on water balance and serum protein ratios, the employment of the transnasal gastric and duodenal siphonage and intestinal balloons. These measures are occasionally life saving, often beneficial, but frequently unnecessary, since nature provides a wide margin of safety to adjust deviations from the normal, and a patient may suffer more discomfort and annoyance than benefit.

With the Roentgenological examination three weeks after the operation a normal, little accelerated evacuation of the stomach was usually found; in many cases a nice duodenal cap had been formed (fig. 16).

The physiological function of the stomach and duodenum is

preserved as much as possible with this method. Times that a surgeon was especially an anatomist, is past; modern surgery is going to take its bearings more and more in physiological direction. It is therefore, that the gastrectomy after Billroth I has certainly not only historical value; from physiological standpoint it is "the method of the future".

Summary.

1. The gastrectomy after the first method of Billroth I is the most physiological method of resection. The passage through the duodenum, the normal reflex centre of gall and pancreatic juice production, is preserved so that a normal stimulation of the greater digestive glands is guaranteed. This is especially of great value with large gastrectomies because with them the normal digestion of the stomach has entirely to be taken over by the small intestine.

2. The gastrectomy after Billroth I is entirely safe in suitable cases.

3. From 1 and 2 follows that in our opinion the so-called Billroth I normally deserves preference to the so-called Billroth II.

4. The modification after SCHOEMAKER is radical and at the same time most economical with healthy gastric wall. It enables us to perform even the largest gastrectomies without danger of tension at the suture and so of leakage, whereas at the other side it does not sacrifice needless great parts of healthy gastric wall.

Our experience is that a gastrectomy cannot be made so large that a Billroth I anastomose should no more be possible.

5. With a good technique there is no danger of stenose.

6. Each gastric ulcer can be resected in this way.

7. The non penetrating ulcer of the duodenum can as a rule be mobilized sufficiently for an end to end anastomose; with the penetrating duodenal ulcer with infiltrated wall, we had better give up the Billroth I gastrectomy with a view to possible danger of recurrence and instead of it perform a Billroth II (eventually an exclusion resection after FINSTERER) or a gastroenterostomy.

8. A gastric carcinoma, that can be resected, can nearly always be treated after this method. (This does not refer to cases, where *total* gastrectomy is performed).

9. In cases where a gastrectomy is indicated, we should not ask: Billroth I or Billroth II as a rule, but *when* Billroth I and *when* Billroth II!

This may have objections with a view to standardizing of one's technique, but do not forget that the patient is most profitted with an individualized method of treatment.

10. Finally, we believe that BILLROTH himself, if he could return to earth and see the progress of gastric surgery, certainly would perform in many cases a Billroth I gastrectomy!

Zusammenfassung.

1. Die Gastrektomie nach der ersten Methode von Billroth I stellt die physiologischste Resektionsart dar. Die Passage durch das Duodenum, das normale Reflexzentrum für die Produktion von Galle und Pankreassekret, ist beibehalten, so dass eine normale Anregung der grossen Verdauungsdrüsen gewährleistet ist. Dies ist besonders bei umfangreichen Gastrektomien von grossem Wert, da nach denselben die normale Magenverdauung gänzlich vom Dünndarm übernommen werden muss.

2. Die Gastrektomie nach Billroth I ist in geeigneten Fällen durchaus ungefährlich.

3. Aus 1 und 2 folgt, dass unserer Ansicht nach der sog. Billroth I normalerweise vor dem sog. Billroth II den Vorzug verdient.

4. Die SCHOEMAKER'sche Modifikation ist radikal und gleichzeitig am sparsamsten mit gesunder Magenwandung. Sie gibt uns die Möglichkeit, selbst die umfangreichsten Gastrektomien vorzunehmen, ohne die Gefahr einer Zerrung der Naht und somit eines Versagens derselben, und opfert andererseits nicht unnötig grosse Partien gesunder Magenwand.

Unserer Erfahrung nach kann keine Gastrektomie so gross sein, dass es nicht möglich wäre, eine Billroth I-Anastomose anzulegen.

5. Bei guter Technik liegt keine Gefahr einer Stenose vor.

6. Jedes Magengeschwür kann in dieser Weise reseziert werden.

7. Ein nicht-penetrierendes Geschwür des Duodenums lässt sich zumeist so weit mobilisieren, dass eine Ende-an-Ende-Anastomose angelegt werden kann. Bei penetrierenden Duodenalgeschwüren mit infiltrierter Wandung tun wir klug daran, in Anbetracht der möglichen Gefahr eines Rückfalls auf die Gastrektomie nach Billroth I zu verzichten und stattdessen einen Billroth II (evtl. eine Exklusionsresektion nach FINSTERER) oder eine Gastroenterostomie anzulegen.

8. Ein Magenkrebs, der resezierbar ist, kann fast immer nach

dieser Methode angegangen werden. (Dies gilt jedoch nicht für Fälle, wo eine *totale* Gastrektomie vorgenommen wird.)

9. In Fällen, wo eine Gastrektomie angezeigt ist, sollten wir uns nicht fragen: Billroth I oder Billroth II als Regel, sondern *wann* Billroth I und *wann* Billroth II?

Dies mag auf Einwände stossen, wenn man darauf bedacht ist, seine Technik zu standardisieren, doch darf man nicht vergessen, dass dem Kranken mit einer individualisierenden Behandlungsmethode am besten gedient ist.

10. Schliesslich sind wir der Ansicht, dass Billroth selber, wenn er ins Leben wiederkehren und die Fortschritte der Magen Chirurgie sehen könnte, sicherlich in vielen Fällen eine Gastrektomie nach Billroth I vornehmen würde.

Résumé.

1) La gastrectomie selon la première methode de Billroth I est le procédé de résection le plus physiologique. Le passage à travers le duodénum, qui est le centre réflexogène normal pour la production de la bile et du suc pancréatique, est préservé, de sorte qu'une stimulation normale des grandes glandes digestives est garantie. Cela est d'une valeur spécialement appréciable dans les gastrectomies larges où c'est l'intestin grêle qui doit se charger entièrement de la digestion stomacale normale.

2) La gastrectomie selon Billroth I est tout à fait sûre dans les cas appropriés.

3) Il suit de ce qui est exposé sous 1) et 2) que dans notre opinion l'opération dite de Billroth I mérite normalement d'être préférée à celle de Billroth II.

4) La modification indiquée par SCHOEMAKER permet une opération radicale tout en étant très économe de paroi gastrique saine. Elle nous rend capables d'exécuter les gastrectomies même les plus étendues sans danger de tension au niveau des sutures ni de défaut consécutif d'étanchéité, et d'autre part elle évite de sacrifier inutilement de grandes portions de paroi gastrique saine.

Notre expérience est que, même avec les plus vastes gastrectomies, l'anastomose du Billroth I reste toujours possible.

5) Avec une bonne technique il n'y a pas de danger de sténose.

6) Tout ulcère de l'estomac peut être réséqué de cette façon.

7) L'ulcère non pénétrant du duodénum peut dans la règle être mobilisé suffisamment pour établir une anastomose terminale.

terminale; en cas d'ulcère duodénal pénétrant, avec infiltration de la paroi, nous faisons mieux de renoncer à la gastrectomie selon Billroth I à cause du danger possible de récurrence, et d'exécuter à la place un Billroth II (éventuellement une résection pour exclusion, selon FINSTERER) ou une gastro-entérostomie.

8) Un cancer d'estomac encore passible de la résection peut presque toujours être traité par cette méthode (cela ne s'applique point au cas où l'on fait une gastrectomie *totale*).

9) Dans les cas où la gastrectomie est indiqué la question que nous devons nous poser n'est pas: «Billroth I ou Billroth II?» mais bien: «*Quand* faut-il faire un Billroth I et *quand* un Billroth II?»

Cela peut provoquer des objections du point de vue de la standardisation de la nomenclature.

Corrections

Page 160, part 2, line 2: ralis should be oralis.

- 161, line 2: ther should be the.
- 161, > 6: resposition should be reposition.
- 165, part 2, line 1: (1910) should be (1911).
- 167, part 2, line 4: (fig. 7) should be cancelled.
- 168, part 3, line 4: (fig. 7) should be (fig. S).
- 171, part 4, line 1: MONIHAN should be MOYNIHAN.
- 172, line 9: attacked should be attached.
- 173, line 2 from the bottom of the page: (fig. 16) should be (fig. 11).
- 176, Résumé, line 8: stomacale should be gastrique.
- 177, Literature, ALVARES should be ALVAREZ.

— FRASER, J.: Journ. Int. de Chir. 1936 (I), 395. — v. HABERER, H.: Zentrbl. f. Chir. 1930, 66; Münchener Med. Woch.schr., 1933, 915. — IGLAUER, S. and MOLT, W. F.: Int. Abstr. of Surgery 70 (1940), 330. — TEN KATE, J.: The tubular gastrectomy, Leiden 1940. — KULENKAMPFF, D.: Der Chirurg. 1933-670. — MAYO, W. J.: Surgery, Gyn. etc. 36 (1923), 447. — NOETZEL, W.: Deutsch. Zeitschr. f. Chir. 205, 391. — RIVERS and MASON: See EUSTERMAN and BALFOUR. — SCHOEMAKER, J.: Dissertatie (These), 1896. — Surgery, Gyn., etc. 33 (1921), 591. — Arch. f. klin. Chir. 94 (1911), 541. — Hunterian Lecture London, 18. 1. 1937.

Till Redaktionen insända böcker:

Jens L. Hansen: Ändringar i Ulcus-sygdommens Fremtræden.
Ejnar Munksgaards Förlag. Köpenhamn. Pris kr. 15: —.

From the Surgical Department D. of Rigshospitalet, Copenhagen.
(Chief Surgeon: Professor S. KJÆRGAARD.)

On Urinary Lithiasis in Childhood.

A Clinical Study of 71 Cases of Urinary Calculi in Children.

By

C. C. WINKEL SMITH.

In a synopsis on urinary lithiasis in childhood (*Acta chir. scand.* Vol.XC 1944) based on a review of the literature the author pointed out that several aspects of the incidence, clinical features, prognosis, and treatment of the disease hardly can be said to have been finally elucidated. The following study of a clinical material aims at contributing further to the illustration of various aspects of the clinical features of urinary lithiasis in childhood, taking special regard to prognosis and treatment.

Material.

The present material of urinary calculi in children comprises a total of 71 cases collected from the various Copenhagen hospitals during the period 1929—1943 inclusive. The majority of the patients have been admitted to the 4 large pediatric departments: Dronning Louises Børnehospital 12 cases, Børnehospitalet Fuglebakken 11 cases, the pediatric department of Rigshospitalet 12 cases, and the pediatric department of Sundby Hospital 10 cases, but the material also comprises cases directly admitted to the various surgical departments of the Copenhagen hospitals.¹

¹ My thanks are due to the chiefs of the various departments for the permission to use the case records.

I am also greatly indebted to Professor FLEMING MÖLLER, the chief of the X-ray department of Rigshospitalet, and FLENNING NØRGAARD, M. D., for their willingness and helpfulness in reviewing X-ray films.

The period 1929—1943 has been chosen on account of the fact that about 1929 intravenous urography was introduced as a routine method of examination in most hospitals, so that this period may be said to mark a natural threshold between old and modern diagnostic procedures in diseases of the urinary tract.

60 of the 71 cases are from Greater Copenhagen, whereas 11 came from other parts of the country, admitted chiefly to the pediatric department of Rigshospitalet. The age limit is 15, meaning that in this material the demonstration of the calculi has taken place before the age of 15 years. In three cases only the diagnosis was passed at autopsy, in all the rest in living children.

Incidence.

71 cases of urinary lithiasis in children during a period of 15 years serve to indicate that the disease hardly can be called uncommon in Denmark. Furthermore, it strikes one that in the course of 73 years (1850—1923) CHRISTENSEN only could report 16 cases of urinary calculi in children from Dronning Louises Børnehospital, whereas the present material reveals that 12 patients suffering from the same disease have been admitted to the same hospital during a subsequent period of barely 15 years (1929—1943).

This obviously increased number of cases may of course for a great part be attributed to the advent of the X-ray and the considerable development of roentgenography during recent years. This, however, hardly is the sole explanation, considering that the great majority of urinary calculi reveal a positive shadow on the film and thus should be fairly easily demonstrable, even with inadequate X-ray technique. KRETSCHMER found a direct shadow in 20 out of his 21 cases of lithiasis in childhood, even 5 cystine calculi gave a shadow. Correspondingly, a positive shadow was demonstrable in all the present cases, except one, a 6-year old girl with a pure uric acid stone in one kidney.

It therefore seems reasonable to presume that there has been an increase in the cases of urinary lithiasis in children in Denmark. This increase does not, however, seem to have taken place within the period under observation (1929—1943). The distribution of the 71 cases within the period (Fig. 1). reveals that the cases are so comparatively evenly distributed all over the period that an increase cannot be considered to have taken place during this space of time.

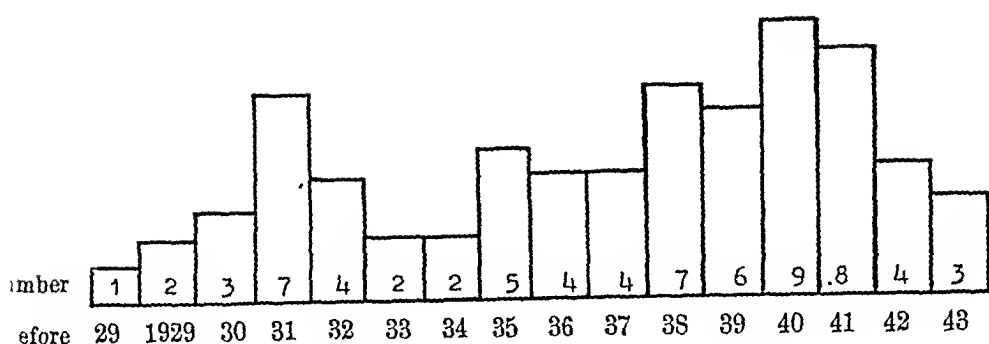


Fig. 1. Distribution of 71 cases of urinary calculi in children during the period 1929—1943.

But another possibility is an increase before 1929 which might correspond to the waves of calculi which *inter alia* are considered to have been demonstrated about 1920 in Central Europe (GROSSMANN) and in Sweden (HELLSTRÖM).

Sex. Age.

Out of the 71 cases 51 were male and 20 female, showing that the males outnumber the females at the ratio of almost 3—1. This is in agreement with KRETSCHMER as well as THOMAS & TANNER who found the ratio male-female to be about 3—1, and roughly corresponds to the proportion found in the case of adults, where e. g. HELLSTRÖM found 66.4 per cent males in his material of 750 cases.

Considerable clinical as well as theoretical interest attaches to the question of age. Fig. 2 shows the relative ages at the time of the diagnosis. It appears that almost 50 per cent of the stones were demonstrated before the age of 6, 5 already before the age of 12 months, and further 3 before the age of 2 years.

On the other hand Fig. 3, showing the onset of the symptoms, gives a somewhat different impression, no less than 25 children having revealed symptoms before the age of 3 and 41 (i. e. almost $\frac{2}{3}$) before the age of 5. Lastly, 8 had symptoms before reaching 12 months, and furthermore, at least 3 cases of stone, viz. 2 coral calculi and 1 calculus demonstrated at the age of 15 months with extensive hydronephrosis and a minimal remainder of renal tissue, must be classed among stones formed before the age of 12 months. Thus a total of 11 children have developed calculi in the urinary tract before reaching the age of 12 months. When considering that a number of the cases included in this material doubtless have been symptomless for a long time before the dia-

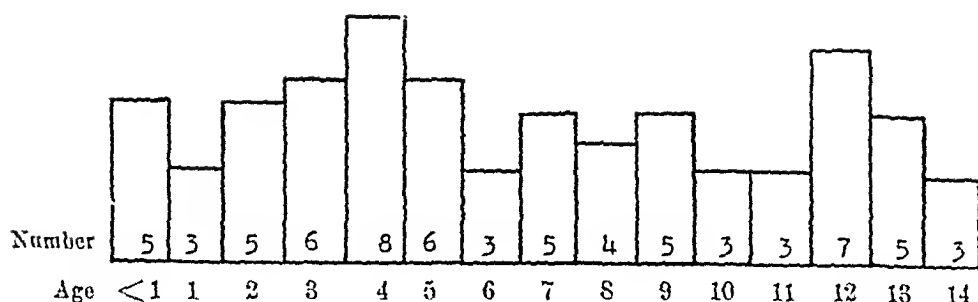


Fig. 2. Age of the patients at the time of diagnosis.

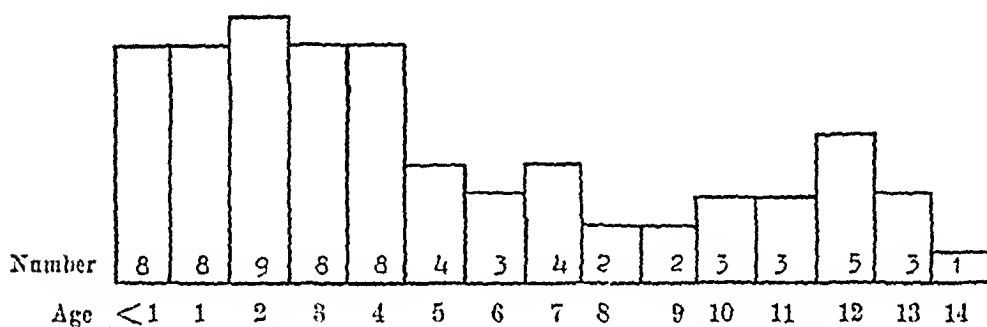


Fig. 3. Age of the patients at the onset of symptoms.

gnosis, judging from the appreciable size of the stones at the onset of symptoms [one case of a coral calculus in a 10-year old boy gave no symptoms before it became infected and in another case 10 ureteral stones, as large as a pea, were demonstrated in a 3-year old boy (Fig. 7)] one inclines to the belief that urinary stone formation in childhood to a great extent dates back from the first years of life. This differs from the findings of THOMAS & TANNER, KRETSCHMER, and CAMPBELL, the demonstration of stones in their patients mostly having occurred much later (most frequently about the age of 7—8 years). But on the other hand the first-mentioned belief is supported by a number of reports, mainly based on autopsy materials collected by COLLINS, showing that 98 cases out of 107 (91 per cent) of calculi in children were demonstrated before the age of 2, 88 of them even before the age of one year.

To some extent the difference apparent from the above-mentioned literature would seem to indicate that stone formation in infancy was fatal, whereas stones occurring later on in childhood should be of a more benign character. But the material under discussion substantiates the already advanced presumption that

if sufficient regard is had to the duration of the symptoms before the diagnosis as well as the size of the stones at the onset of symptoms, it will appear that stone formation in the urinary tract occurs considerably earlier than clinical experience leads one to believe.

Besides its clinical importance, the question is of considerable theoretical interest, it being patent from the above that the formation of stones in the urinary tract in childhood for a great part takes place during infancy. This is therefore the period of the child's life to be considered when trying to penetrate into the question of lithogenesis and illustrate the exogenous and endogenous factors which are of essential importance to the stone formation in the urinary tract.

Location of the Calculi.

Table 1.

Distribution of stones in the urinary tract of 71 children.

Kidney 27	Ureter 19	Bladder 1	Urethra 1		Total 48
Both kidneys 5	Both ureters 1	Both kidneys— both ureters 1	Kidney— ureter 11	Kidney—ureter— bladder 1	19
Both kidneys—bladder 1			One kidney—urethra 1		2
Patients with spontaneous passage of stones.....					2
Total					71

Table 1 reveals that 48 cases were solitary stones while no less than 21 patients had stones in more than one organ at the same time. 13 cases had bilateral involvement (18 per cent). 9 of these cases directly appear from the above table, whereas the remaining 4 are included in the 11 cases forming the group renal-ureteral stones and comprise one case of a stone in one kidney and in both ureters as well as 3 cases of stones in both kidneys and one ureter. When comparing these figures with those reported by HELLSTRÖM who only found 10 per cent simultaneous occurrence of stones in kidneys and ureters and bilateral involvement in 14.7 per cent in adults, it will be seen that multiplicity probably is a more frequent phenomenon in childhood than in adult life.

This is a factor of no slight clinical interest as appears inter alia from the fact that the material under discussion includes at any rate 1 and presumably 2 cases of renal stones where associated ureteral stones were overlooked. This complicated the post-operative course and called for a renewed operation.

The proportion between stones in the upper and lower urinary tract is, however, a still more striking feature of this material. Isolated bladder and urethral stones were only encountered in 2 cases, whereas 64 cases had stones in the upper urinary tract alone (kidneys-ureters) and 3 cases stones in both upper and lower urinary tract simultaneously.

A classification of the only 2 cases of spontaneously voided stones with the group of stones in the lower urinary tract still only would give 4 cases in all, i. e. 5.6 per cent are stones that have passed to the lower urinary tract before the diagnosis, while 94.4 per cent are stones in the upper urinary tract alone.

This is an item of quite astounding divergence from earlier reports on lithiasis in children. Taking the lack of X-ray into consideration, it is not surprising that a number of authors from the last century like V. BOKAY, PERMANN and THOMPSON chiefly found bladder and urethral stones (V. BOKAY 1827 bladder-urethral stones out of 1836, THOMPSON 1028 cases exclusive bladder stones, and PERMANN 4 kidney and 20 bladder stones). But it seems more peculiar that THOMAS & TANNER as late as 1922, at which time roentgenography must be said to be quite well advanced, find that 69 per cent of a material of 203 patients are made up of bladder stones (57 per cent) and urethral stones (12 per cent) and only 31 per cent renal or ureteral stones. In CAMPBELL's material from 1930 the difference is less marked, only 4 out of 30 being pure bladder stones, whereas KRETSCHMER, as late as 1935, found pure bladder stones in 7 out of 21 cases of urinary calculi.

It is difficult to give a reason for this divergency. The most obvious thing would be to presume that improved X-ray technique had made it possible to establish a diagnosis in a number of cases which formerly were indemonstrable. In that case, however, the bladder and urethral stones should be supplemented instead of substituted as in the present material, unless the renal and ureteral stones were of a size that would permit of a later migration into the bladder, where they could be demonstrated at a later date. But it appears from the following that in

nearly all the cases in the material under discussion the stones were of such an appreciable size that their chances of passing from kidney or ureter to the bladder have been nil or at any rate minimal.

It is improbable that a greater or less number of bladder or urethral stones should directly have been overlooked in this country during the period from 1929—1943, considering the fact that according to other reports the bladder stones in question have been so large as to call for surgical removal. (In THOMAS' and TANNER's report 81 cystotomies were performed, and all KRETSCHMER's bladder stones involved either cystotomy or litholapaxy).

The fact that the present material hardly includes any bladder stones cannot be explained, but as already mentioned, the results of earlier observers in all cases indicate that in diagnosing urinary calculi in children, the examiner should carefully consider the lower urinary tract as well.

Spontaneous Passage of Stones.

Stones had passed down spontaneously in 26 cases of this material. In 12 cases one or more stones were voided, whereupon the patient recovered without requiring a later operation. In the remaining cases stones were voided, but the lithiasis persisted. In most of the cases the passage of the stones was observed directly, but in 4 cases the spontaneous voiding was only ascertained by the fact that a formerly distinctly demonstrable shadow on the X-ray film had disappeared at a later sitting. In 3 of these cases the voiding of the stones occurred during the stay in hospital, without the stone having been specially searched for and therefore not demonstrated. This shows that a close control of the urine with regular daily filtering is a condition for the demonstration of stones, and in some cases for the passing of the diagnosis, if the stone has been too small to give a shadow on the roentgen film. It is therefore reasonable to presume that a number of children who in the course of time have been treated under vague diagnoses like abdominal colic, hematuria, etc. actually have voided urinary calculi which never have been demonstrated.

While most of the cases of spontaneous passage of stones have been of a purely transient character, one of the patients deserves

quite special interest. From the age of 11 months up to 4 years he voided a total of 100 stones (oxalate stones) whereupon the stone formation ceased. After examination at the age of 7 including X-ray, revealed no stones. This case proves the correctness of the presumption advanced from various quarters that stone formation in the urinary tract is characteristic of certain periods of life.

Chemical Composition of the Stones.

In 33 cases the stones have been subjected to chemical analysis, and Table 2 reveals that 31 were the so-called primary aseptic stones, composed of calcium oxalate, urate, phosphate, whereas only 2 were infected. These figures indicate that urinary calculi

Table 2.

<i>Own Material (Children)</i>		<i>Hellström (adults)</i>	
Calcium oxalate	18	Oxalate stones.....	63 per cent
Oxalate—phosphate	5	(oxalate—phosphate)	
Uric acid—urate	5	Uric acid—urate	5 " "
Calcium phosphate	3	Phosphate	5 " "
Infected stones	2	Infected stones	22 " "

in children mostly are of the primary aseptic type. Furthermore, they imply that the local element of infection at any rate only plays a subordinate rôle in urinary stone formation during childhood.

Etiology.

The space being limited and the material under discussion not containing positive information on the subject, I shall only briefly mention the etiology of urinary stones. No positive illustration is afforded by the anamneses which contain examination as to heredity, alimentation, calcium metabolism, and infectious diseases. But it is peculiar to observe families of many healthy children, all living on the same diet and subject to the same heredity, including one suffering from lithiasis, so that neither heredity nor alimentation seem to be of essential significance.

The Etiological Significance of Anomalies of the Urinary Tract.

In 58 of the cases it has been possible to examine the significance of the anomalies of the urinary tract in relation to stone formation. It appears from Table 3 how often the urinary tract

(Fig. 4-6 = Tables 1-3.)



Fig. 7. Boy, aged 3. A series of pea-sized ureteral stones on the right side.

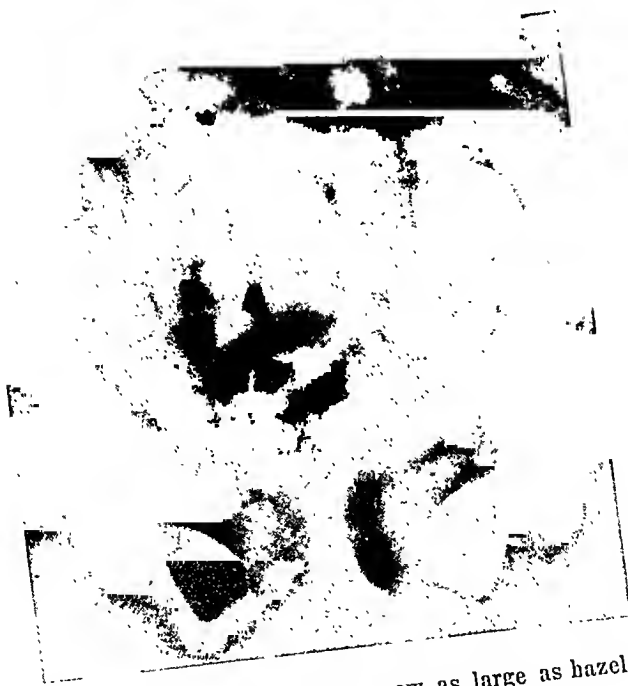


Fig. 8. The same boy, aged 8 1/2. Stones now as large as hazel nuts. Removed by ureterolithotomy.

SMITH: Urinary Lithiasis in Childhood.



Fig. 9 a. The same boy, aged 13. Now 2 large conglomerations of small stones appear in a ureterocele and the ureter. A typical bright halo around the mass of stones in the ureterocele.



Fig. 9 b. The removed small stones.

(Fig. 10—11 = Tables 4—5.)



Fig. 13. The same boy, aged 7. Ureteral stone considerably larger. Severe hydro-nephrosis



Fig. 12. Boy, aged 4. X-ray-diagnosis; Right megalo-ureter. Overlooked ureteral stone in the position of the 2nd-3rd sacral segment.



Fig. 14. Boy, aged 4. Multiple stones of both kidneys.

Fig. 15. The same boy, aged 12. Number of stones considerably increased in both kidneys. Quite symptomless for long periods. Not infected.

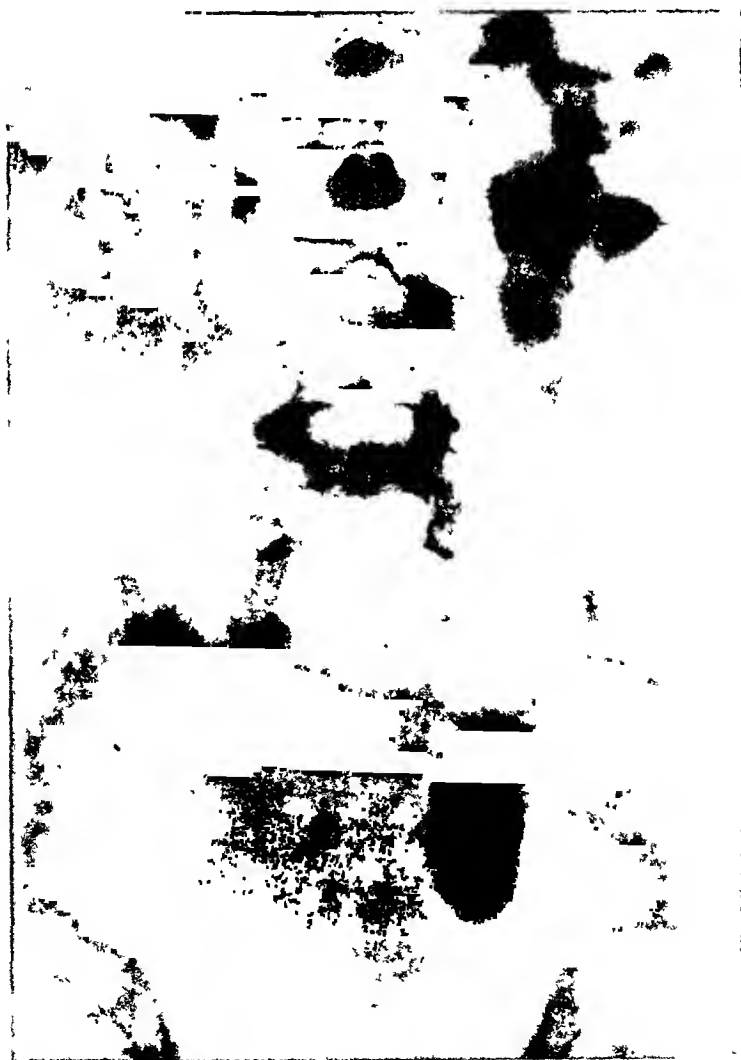


Fig. 16. Boy, aged 9. Diagnosis: Stricture of left ureter.

has revealed such severe morphological changes that a diagnosis of anomaly has had to be considered.

Table 3.

Stricture in the uretero-pelvic juncture	2
Stricture in the lower portion of the ureter	2
Doubtful stricture in the upper portion of the ureter	1
Double ureter	3
Double kidney and double ureter anastomosing in a common ureteroceles ..	1
Hydronephrosis caused by aberrant vessels	1
Primary megalo-ureter ?	1

On the whole the material proves that anomalies in conjunction with stone formation in the urinary tract is a rather frequent phenomenon, without, however, being of any great, let alone decisive, significance to lithogenesis in the urinary tract of children. Out of the 58 urographed cases 15 thus revealed completely normal urograms, whereas 30 presented major or minor dilatations which must be considered to be secondary to the stone formation, having disappeared after the removal of the stones. The great importance which HUNNER and other authors attach to the frequency of strictures and their great significance to stone formation in the urinary tract can therefore hardly be maintained.

Even in the cases of demonstrable anomalies it is far from certain, whether the latter are of any etiological importance at all to stone formation. In the one case of double ureter the stone thus was localized on the side opposite to the anomaly and in another case of double ureter the stone was lodged in the kidney, quite independent of the ureteral anomaly. In the 2 cases of a stricture in the lower portion of a ureter the lithiasis had been present for a number of years, directly localized to the strictured area, so that it seems reasonable to presume that the stricture was a secondary consequence of the stone and not vice versa.

The significance of strictures as an etiological factor was very doubtful in these cases too.

On the other hand, in the case of double kidney and double ureter anastomosing into a common ureteroceles, the anomaly no doubt was of decisive significance to the stone formation.

Case history; A boy, born Jan. 9, 1930. Admitted to a nursing home for hematuria at the age of 3. Examination revealed nothing abnormal, but a later revision of the X-ray films revealed already at that time several calculous shadows, as large as a pea, in the pelvis minor (Fig. 7). At the age of 6½ and 8 again hematuria and albuminuria. For several

months he was treated under the diagnosis of hemorrhagic nephritis. $8\frac{1}{2}$ years old a urography revealed: left nrogram normal. On the right side there is a double kidney and double ureter, both with extensive dilatations. In one ureter there is half a score of calculi, almost as large as the kernel of a nut (Fig. 8). Urine was not infected. The stones were removed by ureterolithotomy.

From the age of 8 to 13 symptomless. An after-examination in connexion with the present paper (Fig. 9) surprisingly revealed 2 apparently independent conglomerations of stones measuring 4×5 and 4×6 centimetres respectively in the position of one of the dilated ureters. Roentgenological and cystoscopic examinations reveal the existence of a ureterocele.

At operation the 2 conglomerations of calculi were found to consist of a total of 1300—1400 greyish yellow faceted small stones, as large as the head of a pin, partly filling the plum-sized ureterocele which projected into the bladder, partly moulding the entire lower end of one ureter. Both ureters were seen to anastomose into a common ureterocele.

Considering that the urography showed quick, good excretion on the affected side and no infection, the surgeon decided on conservative treatment, merely removing the stones and extirpating the ureterocele.

Owing to the fact that the second ureterolithotomy only revealed quite small stones and none of even approximately the size of those removed at the first operation, it is presumably a question of a genuine recurrence. The ureterocele, therefore, no doubt has been of decisive significance to the secondary and probably also to the primary lithogenesis in the ureter.

In 1 case the diagnosis of primary megalo-ureter with secondary stone formation must be ventilated, it being a question of a violent dilatation in relation to slight stone formation. But genetically it is of course impossible to decide which has been primary and which secondary, especially as no cystography was performed with a differential diagnosis in mind.

The experience to be derived from the present material with regard to the etiological importance of anomalous urinary organs to stone formation in the urinary tract may be summarized thus: The forms of anomalies causing stasis in the urinary tract may be conducive to stone formation, without playing a decisive part in urinary stone formation, many and even the predominant majority of urinary calculi being encountered in patients with no demonstrable morphological changes whatever.

On the other hand the anomalies are of some clinical importance, partly complicating the lithiasis by preventing spontaneous passage of the stones, and partly by calling for a more extensive

intervention than planned, a matter which as already mentioned will be dealt with further later on.

Symptoms.

The symptoms of the 71 patients appear from Table 4. As may be seen from the above the most common symptoms were changes in the urine, 48 cases at some time or other having revealed gross hematuria and furthermore 7 cases having microscopic hematuria without macroscopic changes. Nearly as often there was associated pyuria and albuminuria, in 44 and 43 cases respectively, whereas only 30 patients had an infection. The sterile pyuria which was met with in 14 children should thus, when encountered, not only make one suspicious of tuberculosis, but also of urinary lithiasis.

Table 4.

<i>Symptoms:</i>		<i>Types of bacteria:</i>	
Colic	40	Gram-negative rods	6
Gross hematuria	48	Bacillus coli	10
Microscopic hematuria	55	Proteus	10
Albuminuria	43	Staphylococci	6
Pyuria	44		
Casts in the urine	3		
Infection	30		
Fever	31		

Finally, only 3 had casts in the urine.

Although it is evident that changes in the urine are a frequent symptom of urinary calculi in children, it distinctly appears that almost $\frac{1}{3}$ of the patients had no demonstrable changes in the urine of any kind. A normal urine should therefore not be sufficient cause to drop the diagnosis, without further examination of the urinary tract, if pain or anamnesis indicate urinary calculi.

Pain in the form of colicky attacks was present in 40 patients, i. e. only well over 50 per cent, and distributed thus, that pain was observed in 16 out of 32 children with renal calculi, in 15 out of 20 with ureteral calculi, and in 9 out of 15 with combined renal and ureteral calculi.

This differs from several other authors, THOMAS & TANNER e. g. finding colic in 93 per cent of the patients with renal stones and in 70—80 per cent of those with ureteral stones, while KRETSCHEMER found pain in all his 17 patients with renal and ureteral

stones. The divergence perhaps is due to the fact that the present material consists of small children, half of them being below 3 years, whereas the average age in THOMAS' and TANNER's material is as much as 7—8 years, and it of course becomes more difficult to gain exact information the smaller the children are. In the case of renal calculi the pain as a rule is of a vague, persistent character with less objective evidence than the violent colicky pain which is encountered especially in the case of ureteral calculi.

The character of the pain experienced by these patients is on the whole in accordance with earlier reports. It is often a question of vague, abdominal pain of a more or less colicky character which is difficult to localize accurately. In several cases the children had been admitted to the hospital at an earlier date for observation for invagination or appendicitis and discharged, because the urine was normal and therefore did not direct attention towards the urinary tract, and the diagnosis was therefore not established.

In the case of urethral and bladder stones which, as already mentioned, constitute a very small percentage of the entire material, the symptoms were only slightly pronounced, and the stones only manifested themselves by the associated infection which has been maintained by the presence of the stones. It is therefore necessary, in case of a persistent pyuria, to think of the urethra which easily may be the site of a stone, unnoticed even by older children.

An interesting light is thrown on this question by the case history of a boy, born Sept. 12, 1926, case record 420/43 of Department D. of Rigshospitalet.

Pyuria since the age of 4. At 12 nephrectomy for right-sided pyonephrosis at a provincial hospital (diagnosis: ureteral stricture?). At the age of 16 admitted to Department D of Rigshospitalet for pyuria which had persisted ever since the nephrectomy. in spite of energetic treatment several times. A stone, the size of an almond, was demonstrated in the urethra at the root of the penis. After simple extraction the pyuria yielded to energetic treatment in the course of a fortnight.

For two reasons the case is of interest. In the first place the demonstrated urethral stone no doubt has kept up a urinary infection for years, and in the second place it reveals that even a boy of 16 may unknowingly have a large concretion in the urethra.

Apart from these more manifest symptoms it has been rather striking to notice how the parents in many cases have declared that the children remained at a standstill and thrived badly

during the illness in order suddenly to change and flourish after the surgical removal of the stone.

I did not succeed in finding demonstrable signs of checked growth in the 4 cases where I tried to elucidate the question by further examination (including X-rays of bone nuclei). Neither were there signs of renal rachitis as described by LUCAS and others in connexion with renal diseases of various kinds in children. But all the same it is wise to presume that a urinary concretion in childhood does not only cause local damage to the urinary organs, but also indirectly has a restraining effect on the entire organism, leaving its detrimental marks.

Diagnosis.

When once the attention is directed towards the urinary tract the diagnostic procedures within this region, including urography, pyelography, cystoscopy, and cystography, are now so well advanced that a diagnosis may be passed without special difficulty. Let it, however, be emphasized that nothing short of a really thorough examination will suffice.

But it appears from the material that this rule has not been complied with in a number of cases. In these cases one has been content with a more symptomatic diagnosis based exclusively on urine findings, without a roentgenogram. Not less than 10 patients had thus been admitted to a hospital once before under the diagnosis of hemorrhagic nephritis and 2 twice under the same diagnosis, although the anamnesis in only one of the cases justified the belief that there was an actual hemorrhagic nephritis, which presumably had arisen as a complication to preceding lithiasis.

6 patients had earlier been admitted under the diagnosis of pyuria, 1 under the diagnosis of pyelonephritis, 2 under the diagnosis of acute abdomen and acute appendicitis. This serves to urge to a thorough urologic examination in case the anamnesis indicates a lesion of the urinary tract, or when encountering a urinary disease of a somewhat unusual course.

The direct pyelography as well as urography in the case of children is of importance in order to obtain as accurate details as possible concerning the urinary tract, especially with regard to the question of strictures, valve formations, or other anoma-

lous conditions. The age limit for performing direct pyelography is usually fixed at 11—12 months in the case of girls and 5—6 years in the case of boys, provided the adequate infant instruments are available.

Besides cystoscopy, cystography may be a helpful procedure, especially in the case of small children where cystoscopy is unmanageable. Cystography may afford information about the condition of the ureteral orifices and reveal the existence of primary or secondary hydronephrosis by demonstrating the presence or absence of reflux. The matter is important. For if, after a urography, one is satisfied with having ascertained a primary dilatation — a megalo-ureter — one may overlook the possibility of a mechanical condition causing the dilatation, and thereby lose one's chance of removing the actual cause of the lesion. In that case a cystography will serve to decide whether the dilatation is primary or secondary. If there is no reflux there is a predominant probability of a secondary hydronephrosis for which reason a further search must be made for the actual cause of the dilatation. 2 cases of the present material serve to illustrate the diagnostic importance of cystography. In the one case the erroneous diagnosis of primary megalo-ureter was passed despite the fact that a cystography revealed the absence of ureteral reflux. The actual cause of the dilatation, a large ureteral calculus, was not demonstrated until 3 years later. A revision of the roentgenograms revealed that the stone had been overlooked at the first examination (Figs. 12—13).

The surgical removal of the stone thus was delayed for 3 years, during which time both infection and dilatation had become so far advanced that a post-operative treatment of the infection, preceded by a conservative operation, was of no effect.

In the second case too a diagnosis of ureteral calculus — megalo-ureter — was passed. Cystography was omitted. Had it been performed it would have revealed the absence of reflux, directing the attention towards the ureteral orifice, and a ureterocele would probably have been diagnosed already at the first operation. But now the ureterocele was not recognized until 5 years later, when a recurrence of the stone was demonstrated.

Another important examination is the daily routine inspection, perhaps also filtering, of the urine of these patients, as it otherwise repeatedly happens that stones are voided without being recovered as already mentioned under the heading of spontaneous passage.

Treatment.

53 patients underwent one or more operations (63 operations in all). 2 of the remaining 18 refused operation, 12 voided the stone spontaneously and recovered, 1 was discharged without treatment, because the stone was quite tiny. Finally 3 reached the autopsy table before the diagnosis was passed.

Table 5 shows the surgical interventions performed.

Table 5.

Isolated interventions:

Primary nephrectomy	7
Nephrolithotomy	6
Pyelolithotomy	17
Ureterolithotomy	10
Cystolithotomy	2
Urethrolithotomy	1
Simple lithotomy in a total of	36
Resection of aberrant vessels	1

More than one intervention on the same patient:

Pyelolithotomy — ureterolithotomy	2
Cystolithotomy — ureterolithotomy — nephrectomy	1
Urethrolithotomy — pyelolithotomy	1
Pyelolithotomy — nephrectomy	3
Ureterolithotomy — nephrectomy	1
Exploratory ureterotomy — nephrectomy	1
	<u>53</u>

Spontaneous passage	12
Fate uncertain	1
Operation refused	2
Diagnosis passed at autopsy	3
	<u>71</u>

It appears that 75 per cent of the cases have been treated surgically, which furthermore was suggested in 4 cases. This figure is very high as compared with e. g. HELLSTRÖM's material of adults with only 46 per cent operations. The operative indications in the present material mainly seem to have been well-founded, and in the great majority of cases adequate attention has been paid to the size of the stones, infection, and urinary stasis. Therefore the reason for the high operation percentage is hardly to be found in the most obvious explanation, viz. that the operative indications have surpassed those in HELLSTRÖM's

material, but much rather in the fact that a number of cases ending in a spontaneous cure, as earlier mentioned and presumed, do not get as far as entering the hospitals, or at any rate are not recognized as suffering from lithiasis.

Out of the 53 patients 44 were operated upon immediately after the demonstration of the stone. In 9 cases the operation was not performed until months or years, in one case even 12 years, after the demonstration. In 7 of these cases the delayed operation was due to lacking operative indication at the time, whereas 2 of the patients for private reasons, unknown to the author, did not submit to operation until years after the demonstration of the stones.

As appears from the table the most common procedure was simple removal of the stone, either in the form of nephrotomy, pyelotomy, ureterotomy, cystotomy, or urethrotomy in 38 cases, and primary nephrectomy in 7 cases, 3 on account of a large coral calculus and 4 on account of multiple stones in one kidney, in one case complicated by a stricture in the uretero-pelvic junction.

In one patient it became necessary to remove a stone from the urethra and from the left kidney with a brief interval and in another first a bladder stone, and years later a stone was removed from the right kidney simultaneously with a left-sided nephrectomy because of a stone which did exist already at the time of the removal of the bladder stone.

It is interesting to have a further look at the 4 cases in which lithotomy and later nephrectomy was performed with some intervals:

(1) J. E. K. a boy, aged 18 months, coral calculus in right pelvis, infected. Gram-negative rods. Stone removed by pyelolithotomy — nephrotomy removing first the large stone through the pelvis and a broken corner by nephrotomy. A control roentgenogram was not taken after the operation. Infection persisted in the spite of treatment. Already 2 months later a roentgenogram again revealed a stone shadow (false recurrence?) which quickly increased, was complicated by infection, for which reason nephrectomy was performed one and one-half years after the first operation.

(2) A boy, aged 5½. Hematuria, pyuria, proteus. X-ray: Stone, the size of a pea, in left kidney. Urography normal without dilatation. By nephrolithotomy a small conglomeration of stones, as large as millet seeds, was removed from the kidney substance. Control roentgenogram one week after the operation revealed the concretion in the kidney unchanged, just as before the operation. 5 months later roent-

genogram still revealed the concretion. Infection persisted. General condition: weak. A pea-sized concretion in the lower portion of the left ureter was now discovered (the films necessary to decide whether this concretion has been overlooked at the first operation are unobtainable). Pyelography revealed a violent dilatation of the ureter. 5 months after the first operation nephrectomy including removal of the ureteral stone as well.

(3) A boy. 2 years febrile pyuria, at the age of $2\frac{1}{2}$ 4 stones were demonstrated in right kidney, slight hydronephrosis, left urogram normal. Urine: + pyuria, growth of Gram-negative rods. 4 stones removed by pyelolithotomy. After the operation still highly feverish. Roentgenogram 3 weeks later showed a concretion, the size of a pea, in the lower portion of right uréter, the presence of which before the first operation was proved by revising the films. Repeated operation 1 month after the first one revealed perirenal abscess. Nephrectomy. The infection in the urinary tract persisted (no mention is made of disinfectants). 3 months later the patient died. Autopsy: left pyonephrosis, ureteral dilatation (\div stone, \div stricture). As mentioned above the urogram of the left side had primarily been normal.

(4) A boy. At the age of 3 operated upon for ureteral stone. 6 years later ureteral stricture. Nephrectomy. For details see below.

The three cases are instructive in various ways, considering that a second operation might have been avoided. In the first case of a large coral calculus + infection primary nephrectomy would probably have been the method of choice. In the second case a roentgenogram during the operation could possibly have revealed the remaining stone and confirmed a suspicion of an overlooked, associated ureteral stone. In the third case too the ureteral stone probably was overlooked. The left urogram being normal at the time, a primary, radical intervention might have saved the patient.

As regards the treatment of the ureteral stones, it strikes one that 14 operations have been performed on a material of 32 stones, which is almost 50 per cent. This is at variance with the prevailing opinion as to the treatment of ureteral stones in adults as well as children. Here as well as in case of the other operations of this material it is a question as to whether the interpretation of the indications has been extended further than necessary. Considering that the material is collected from several surgical departments, it is of course very difficult to form a reliable opinion of the indications for the operations performed, but they do not at all seem to have been extended too far.

The operated cases were the following:

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No.	Size of stone	Age of patient	Duration of lithiasis	Infection	Complications
1	date stone	13 years	presumably 6—7 years	÷	considerable dilatation
2	almond	3 "	2 "	+	later ureteral stricture
3	4½ cm	7 "	at least 4 years	+	considerable dilatation and periureteritis
4	2½ "	6 "	at least 3 years	+	considerable periureteritis
5	2 "	3 "	presumably 2 years	+	considerable dilatation
6	lentil	12 "	presumably 4 years	÷	considerable dilatation impassable to catheter
7	10 hazel nut kernel	8 "	at least 5 years	÷	violent dilatation of ureter (ureterocele)
8	pea	4 "	?	?	bilateral renal and ureteral stones, violent dilatation
9	cherry	5 "	at least one year	?	no certain dilatation
10	?	7 "	presumably 3 years	+	very considerable dilatation
11	?	11 "	4 "	+	increasing dilatation
12	hazel nut	19 "	?	+	operation for bladder stone at age of 3. Stone causes violent right-sided hydro-nephrosis. Opposite side large coral calculus involving left-sided nephrectomy shortly after
13	orange seed	9 "	1 month	÷	÷ urography
14	1 cm in length	14 "	1 "	÷	delayed excretion, but no dilatation.

As far as may be seen from the above, nearly all the cases have offered marked indications for lithotomy. The chances of spontaneous passage could no doubt justly be considered exceedingly small, when taking into account the appreciable size of the stones, the length of time they had existed, the associated dilatation and marked infection. Only in the last 2 cases the condition seems to have been so new and the stones so small that it would have been reasonable to put off the operation.

A review of the above cases shows that it hardly is quite justified to consider ureteral stones in children to be quite so harmless a disease as many authors seem to do, and to adapt so conservative an attitude as advocated by most authors. In the present material several cases serve to demonstrate that irreparable dan-

age may be done by a too conservative attitude. 2 cases give every reason to believe that a long persisting ureteral stone has been the cause of a later stricture in the ureter. Further, 2 cases had such persistent and extensive hydronephrosis and infection that secondary stone formation in the kidney resulted in both cases, one resulting in nephrectomy and the other having developed such severe pathological changes that a nephrectomy is inevitable.

On the other hand let me emphasize 2 circumstances in defence of the more conservative treatment of ureteral stones. Firstly, as already emphasized and apparent from the material, even fairly large stones may pass through a child's ureter (the present material contains a case of spontaneous passage of a stone as large as a bean). Furthermore, as already suggested, the material perhaps ought to be supplemented with a series of cases of spontaneous passage which have escaped diagnosis, so that the ratio unoperated-operated stones actually would be displaced, resulting in a lower operation percentage.

At all events the conclusion is that in case of ureteral calculi in childhood early diagnosis and immediately performed conservative treatment must be the aim. A continued close observation must be effected in case the stones are not voided, and a lacking spontaneous passage, infection, and dilatation should entail early intervention in order to, if possible, save the kidney and avoid nephrectomy.

The treatment of bladder and urethral stones presents no problem. In this material cystotomy and uretrotomy have been made in cases where the stone could not be removed by way of the urethra.

Regarding the question as to the treatment of the anomalous conditions encountered in the present material, nephrectomy was performed in one infected case of a stricture in the lower portion of the ureter and plastic treatment in another. Stricture at the uretero-pelvic juncture in one case involved nephrectomy instead of conservative lithotomy. Another case of stricture at the uretero-pelvic juncture was only discovered at autopsy, which rendered the question of treatment superfluous. Lastly, in one case of a ureterocele filled with small stones (already mentioned under the etiological significance of anomalies) extirpation of the ureterocele + stones was performed through cystotomy, and at the same

time the stones demonstrated in the ureter were removed by ureterolithotomy.

It is presumably impossible to decide whether the surgical treatment of the strictures in the cases presented has proved correct or not. In the first case of stricture in the lower portion of the ureter, nephrectomy instead of a conservative treatment does seem to have proved fatal to the patient. The fact is that the removed kidney turned out to be grossly almost normal in spite of a roentgenographic finding of a violent hydronephrosis. A year later he developed a stone on the opposite side which 6 years later lead to death in a state of uremia. On the other hand too conservative an attitude may no doubt be just as dangerous as a radical one, considering that an infection may persist and possibly later spread to the opposite side and become a menace to life.

The question conservative versus radical intervention therefore in each case must be left to a number of factors like the extent of the hydronephrosis and infection, the kind of the germs, as well as bilateral stones or anomalies which may become the decisive factor in favour of a more conservative treatment than otherwise intended.

Another point of great importance in the surgical treatment of urinary stones is the controlling of a possible associated infection, especially post-operatively, a point which is far from having been sufficiently observed in all of the cases presented. It is true that an infection occasionally does subside spontaneously on removal of the stone or nephrectomy, but it is by no means the general rule, and the material here presented contains several cases of a pyelitis recurring on the same or the opposite side during the next few years in patients where the infection has not been treated thoroughly enough after the operation. In one such case a nephrectomy was even followed by a doubtless secondary pyonephrosis with a fatal issue in the case of a scarcely 3-year old boy.

An absolutely sterile urine post-operatively must therefore as far as possible be the aim to avoid secondary complications.

The significance of the infection to the prognosis may also be seen from the fact that in all 12 cases of spontaneous passage the stones were aseptic, whereas not one case of infected urinary calculi followed a spontaneous course. It will be seen below that recurrences of infected stones are at least twice as common as those of aseptic stones.

Operative Mortality.

The operative mortality rate has been exceedingly low. In one case only did death occur in connexion with the operation. The patient was a 2½ year old boy with a large coral calculus in one kidney, but otherwise healthy and unaffected by his kidney trouble. A few hours after a conservative lithotomy death occurred in connexion with a sudden attack of convulsion.

In all the other cases the intervention was extremely well tolerated, even by small children who constitute a large percentage of the operated patients. Not less than 18 were thus submitted to operation before reaching the age of 6, including one baby of 12 months and another just rounding the first year, the remaining 16 being equally distributed between 2 and 5.

This is in accordance with HINDMARSCH and HOLMBERG (Nordisk Medicin 1769—1940 and Aeta chir. scand. 287—1942) who find that even infants on the whole tolerate operation extremely well. In 26 cases of operations on the urinary tract they found no deaths. Correspondingly THOMAS & TANNER report a mortality rate of 0.6 per cent, in which connexion, however, it must be emphasized that 78 per cent of the interventions were bladder and urethra operations. The figures must suffice to substantiate that the matter of age alone should not prevent an operation in case it otherwise is clearly indicated.

Recurrence.

In the 12 cases of spontaneous passage there were, as mentioned above, 2 recurrences. The one voided a stone a year later and the other voided 100 stones in the course of 3 years, before the lithiasis came to a spontaneous stop.

Out of the 53 operated patients 4 were not included in the after-examination for recurrences, because the operations had been performed as late as 1943, and 6 could not be traced. The after-examination included roentgenograms which, according to expectation, proved a necessary link in the examination, 2 patients with roentgenologically demonstrable stone recurrences having been completely symptomless, even in spite of a very considerable stone formation in the one case.

Among the 43 after-examined patients 32 had no recurrence and 2 revealed a typical false recurrence which quickly resulted in secondary nephrectomy, placing them among the non-recurrences. Actual recurrence was encountered in 9 cases, 7 infected and 2 aseptic, giving a total of 21 per cent recurrences. 24 of the after-examined patients having had infections, the rate of recurrence was 29 per cent in the infected and only 11 per cent in the aseptic cases.

The figures are of course too low to afford a decisive impression of the frequency of recurrence in childhood and the follow-up too brief, being more than 6 years in 15 cases only and varying up to 6 years in the remaining 28. Nevertheless, the figures no doubt are of a certain significance considering that they, with some accuracy, correspond to HELLSTRÖM's findings of a total of 25 per cent in the case of adults.

The fact that recurrences are considerably less frequent in the aseptic than in the infected cases also corresponds to both HELLSTRÖM and ROVSING finding 15—16 per cent recurrence in the aseptic and as much as 55 per cent in the infected cases. In children as well as in adults the question of infection must therefore be taken into account when choosing between a conservative or radical intervention. As mentioned above the considerably higher recurrence rate in the infected cases serves to stress the importance of a post-operative treatment of urinary infection. The advent of the sulphanilamides in the clinical treatment of the urinary tract entitles to the hope that infections may be controlled far more effectively than earlier, so that the high recurrence rate in the infected cases probably can be perceptibly reduced.

Conclusion.

As stated at the outset the aim of the present paper is partly to make a comparison between the clinical features of urinary lithiasis in adults and children, and partly to make an attempt at elucidating the question as to whether the operative indications in case of the adult may be directly transferred to the child.

Taking the first question, no great clinical or symptomatic differences can be said to exist between the adult urinary lithiasis and that of the child, although the localization of the symptoms in case of quite small children often affords certain difficulties.

This is especially marked in cases where the stone only manifests itself by remittent pain, more or less vaguely localized to the abdomen, without being accompanied by urinary changes. This pain is the only symptom in no small amount of cases of urinary calculi in children. In case of the quite symptomless stones of long standing in children as well as adults, the time of diagnosis may be missed, rendering a conservative intervention impossible, when the stone at last is recognized.

Furthermore, the material shows that urinary lithiasis in childhood hardly is as rare as generally presumed. Various things like the lacking cases of bladder and urethral stones and the very high operation percentage of ureteral stones gives reason to believe that considerably more than 71 cases of urinary lithiasis in children have occurred in Copenhagen during the period 1929—1943. The keynote of recent literature on the subject, therefore, no doubt is right in stating that urinary calculi in children are far more common than generally presumed.

In order to form a definite opinion of the question as to the indication for surgical intervention in childhood, it is necessary to consider a whole series of different factors. On the one hand the knowledge of the spontaneous course of the disease and the damage caused to the kidney substance and the efferent ducts of the urinary system by the presence of the stones, and on the other hand the operative risk and the danger of a recurrence with a view to the fact that the operation removes the stone, but not its cause.

As regards the spontaneous course of the disease the material shows the numerous aspects of the syndrome, just as in the case of adults, and the difficulty in forming a view of the further course of the disease in each individual case from a momentary condition.

The material thus contains examples of stones observed for years which have taken 12—14 years to assume a size of any account, as well as examples of stones which in the course of a few years have grown so rapidly that the moment to make a conservative intervention has been missed.

The chances of a spontaneous passage of the stones seem to be just as varying as the pace at which they grow. Partly we have examples of rather small stones which remain impacted in spite of normal urograms with easily passable ureters, and partly examples of the passage of quite large stones without difficulty.

The actual production of the stones also seems to be individual and subject to extreme variations. With some patients it is a case of one single stone, developing so to speak by chance, whereas others go on producing stone after stone for years. The material contains a boy who, between the age of 1—3, produced no less than 100 stones which all passed down spontaneously and left him completely well, whereas 4 other patients with a continued stone formation for years, but without any spontaneous passage to speak of, in a few years had their kidneys filled with numerous, larger or smaller, conglomerations of stones (Figs. 14—15). Even in these cases the course of the disease mostly extends over several years, 2 of them thus had passed the puberty, apparently without being particularly affected by their kidney disease.

As an argument in favour of conservative treatment it has been pointed out, especially by French authors, that by far the large majority of urinary stones only cause minimal damage and very seldom leave irreparable changes in the urinary tract, making the prognosis particularly fine, apart from the severe cases of bilateral involvement.

A review of the material under discussion leaves an impression widely divergent from this view. In the first place one must reckon with a not quite inconsiderable primary mortality from the lithiasis. 4 of the 71 patients died. It is true that 2 of them were infants of 6 and 11 months respectively, who succumbed to a very severe associated urinary infection in the course of a few days. The other 2, on the other hand, died at the age of 16 and 9 years respectively after having suffered from lithiasis for several years.

(1) P. J. S. a boy, aged 13 months, admitted in 1925 for a colipyuria of only a few days standing. X-ray revealed a stone in the kidney, the size of an almond. A few months later the stone was situated in the pelvis minor. Was thought to be a bladder stone, but on operation by the suprapubic approach the bladder was found empty. The pyuria persisted during the following years, but otherwise symptomfree. Re-admitted in 1927, now aged 3. The stone was now $4\frac{1}{2}$ cm. in length, located in the region of the left ureter. An operation revealed a violent dilatation of the ureter. The latter was not probed, so that it is impossible to state whether a stenosis has been present at the time. The stone was removed.

The pyuria persisted unchanged, for which reason the patient again was admitted in 1933 at the age of 9 in connexion with an acute attack of left-sided pyelitis. This time urography, showing quick ex-

cretion on both sides. Right urogram apparently normal, but there is some air in the bowels. On the left side there is a violent hydro-nephrosis and dilatation of the ureter (Fig. 16) which narrows in at the lower end. No stone. Diagnosis: Ureteral stricture ÷ cystoscopy. Left-sided nephrectomy on account of the demonstrated ureteral stricture. The ureter was not probed during the operation. The removed kidney was rather irregular and of a somewhat lobar design. Inter-section revealed the parenchyma almost normal, pelvis dilated. Microscopic examination revealed that the kidney was the seat of chronic inflammatory changes. The ureter was removed above the strictured part, so that no microscopical examination could be made of that portion. Apart from a brief salol treatment, the urinary infection which persisted after the operation received no treatment whatever. 2 years later — in 1935 — initial symptoms from the right kidney which now is the seat of stone formation. Intermittent attacks of obstruction, but operation is refused by the parents. At the age of 16, in 1940, the boy died in his home in a state of uremia.

(2) K. B., born Sept. 15, 1933. In April 1940 the patient was admitted for treatment for hypospadias. Much information cannot be gleaned from the case records, but apart from a disposition to enuresis no further urinary symptoms seem to have existed. Plastic operation for hypospadias. On admission urine sterile. No X-ray. Treated post-operatively with a catheter left in the urethra for some time. Urinary infection soon developed (*Proteus*). During the following year frequently symptoms of cystitis. In July 1941 X-ray revealed a bladder stone as large as a hen's egg, which was immediately removed by cystotomy. In the autumn of 1941 "inflammation of the kidney pelvis" (pyelitis). X-ray shows 2 calculi in the lower part of the right kidney, 1 in the ureter close to the ureteropelvic juncture, and one in the left kidney. The calculi were observed, but considering that the boy seemed unaffected by the lesion and that the size of the stones seemed to vary, an intervention was refrained from. During the following year weak and seedy, loses appetite. In the autumn of 1942 he was admitted in a uremic condition and died in the course of a few days.

At autopsy the left kidney was found to be greatly enlarged. Section into the parenchyma causes the pus to flow freely and the cut surface reveals only a quite narrow edge of the remaining renal parenchyma surrounding numerous cavities filled with pus. The pelvis and ureter violently dilated. About 3 cm. from the bladder there is a ureteral calculus, as large as a pea, which here seems to obstruct the passage through the ureter. The right kidney is small, atrophied, coarsely nodular on the surface. On section the parenchyma is considerably narrowed and in several places, mostly in the apical and basal regions, almost completely lost, the corresponding calices being greatly dilated. In 2 of the basal calices there is one calculus the size of a large pea; and another as large as a Russian pea. There is some dilatation of the pelvis and rather severe dilatation of the right ureter.

Although it cannot be considered quite out of the question that the

bladder stone has appeared in connexion with the treatment in April 1940, when the catheter was left in the urethra for some time, the appreciable size of the stone (hen's egg) indicates a rather long standing. The autopsy also supports this belief, revealing grave, both acute and chronic changes in the entire urinary system; the right kidney was thus quite small and shrunken, which hardly can be the sequel of a just 2-year old lithiasis.

Although operation was performed in both cases, it is obviously the spontaneous course of the lithiasis and the grave changes in the urinary tract worked by the stones in connexion with infection that have been the cause of death. In the first case at least a different attitude in two respects might have improved the chances considerably. Firstly, the ureteral stone ought to have been removed much earlier than it actually was, and secondly nephrectomy should presumably have been substituted with a conservative plastic treatment of the ureter.

Apart from the fatal cases the material also contains examples of other severe changes in the urinary tract, presumably sequels of the lithiasis. Besides the case mentioned above there was another case of a stricture in the ureter in a 6-year old boy who also had been suffering from symptoms of stone + infection from the age of 1, and as mentioned above, it seems reasonable to presume that the stricture was a sequel of the stone.

The removal of the kidney in 7 of the 13 nephrectomies on account of one large coral calculus shows that the time to perform the operation actually had been missed, in most cases because the diagnosis had been established too late.

The introduction of urography has at last supplied a new standard for the sequels left by stones in the urinary tract. As already mentioned 30 of the 58 urographed patients presented signs of more or less extensive hydronephrosis as well as delayed excretion and discharge, proving that the urinary tract and the kidney function do not remain unaffected by a lithiasis. In more than one third of the cases the hydronephrosis was even quite appreciable.

In spite of several examples already mentioned of the peaceful course of lithiasis in childhood and of the occasional slow development of urinary calculi, the large number of severe cases leave no doubt that it must be erroneous to believe that calculi in the urinary tract are rather a harmless disease which does not require treatment, except in the cases of grave subjective symptoms.

As regards the question of the operative mortality and the risk of recurrence it has been dealt with above. As already mentioned the mortality rate following operation at all appearances seems to be very low and thus need not influence the attitude to the operative indication to any extent worth mentioning, even in case of small children. The question regarding the risk of recurrences is more difficult. The aseptic cases must be clearly distinguished from the infected ones, the percentage of recurrence in the former being as low as 11 per cent, but more than twice as high in the latter.

Even 11 per cent must be said to be not quite inconsiderable in the aseptic cases. The fact that the recurrences are not even more frequent can only have one explanation, viz. that stone formation is connected with certain periods of life as mentioned above, so that patients once well out of the lithogenetic period are outside the risk of recurrence.

On the whole the conclusion to be drawn from the present material regarding operative indications seems to be the following:

(1) The indications for surgical removal of calculi in the urinary tract in childhood mainly seem to be the same as in the case of adults, without regard to age, considering that surgical interventions are extremely well tolerated by children, even down to the age of one year.

(2) Calculi showing no sign of migrating or passing down in the course of some months and causing either subjective symptoms or objectively demonstrable urographic changes should, as far as their size allows, be removed, independently of age, so early that conservative intervention still is possible. If the operation is put off, the patient must be kept under continued close observation in order not to miss the correct time for the operation.

(3) Associated urinary infection is a further indication for surgical intervention, the chances of spontaneous passage dwindling, and controlling of the infection becoming impossible. The question as to conservative intervention in the more advanced cases of infection becomes more doubtful on account of the much higher recurrence rate in infected cases. This is a further reason to operate before infection complicates matters. Perhaps the advent of the modern chemotherapeutics will entail a change and reduce the risk of recurrences further than hitherto possible.

(4) The grave bilateral cases must involve a predominantly conservative attitude regarding operative indications as well as the extent of the intervention.

(5) Surgical intervention should be preceded by careful examination with regard to strictures, ureterocele, etc. the presence of which partly influences the extent of the surgical attack and partly requires special treatment.

(6) The treatment of infection in the urinary tract should, as far as possible, be continued after the operation, until a sterile urine has been obtained. The prognosis presumably largely depends on the compliance or non-compliance with this requirement.

Summary.

In three respects the present material differs from earlier reports on the subject: (1) the cases are made up of almost entirely kidney and ureteral stones, (2) urography has been performed systematically in nearly all cases, and (3) after-examination has been effected systematically in nearly all cases.

The material comprises 71 cases of urinary calculi in children derived from the period 1929—1943. The ratio boys—girls was 3—1. The age was evenly distributed between 0—14. The duration of the symptoms before the diagnosis, however, shows that as much as two thirds (a total of 41) presumably have had the stones before the age of 5, whereamongst 8 before the age of 1, and 25 before the age of 3.

Location of the calculi: The material almost exclusively comprises kidney and ureteral stones and only a few bladder and urethral stones. It hereby differs essentially from the majority of earlier published reports of children which chiefly comprise bladder and urethral stones.

Spontaneous passage of stones was observed in 26 patients, in 12 followed by permanent non-recurrence.

The author emphasizes the importance of demonstrating anomalous conditions in the urinary tract with a special view to prognosis and treatment.

Therapy: 53 patients underwent 63 operations in all. Primary nephrectomy was made in 7 cases, simple lithotomy in 36, whereas 9 underwent several operations. It is a striking feature that surgical attacks were made in 14 out of 32 cases of ureteral stones,

a very high operative percentage, which presumably seeks its explanation in the fact that several cases following a spontaneous course never were diagnosed.

The mortality rate following operation is low. In one case only did death occur in connexion with the operation.

Rate of recurrence: Out of 43 after-examined patients (all operated upon) 34 had no recurrence. Recurrences were found in 9 (21 per cent), i. e. a recurrence percentage of 29 in the infected and 11 in the aseptic cases.

Conclusion: Urinary lithiasis in childhood is hardly as rare as assumed in the Scandinavian countries at any rate. It is a disease of an extremely varying course. On the whole, however, considerable damage to the urinary tract must be expected to follow upon urinary lithiasis, so surgical intervention is advisable independent of age.

Zusammenfassung.

Das hier vorliegende Material unterscheidet sich auf 3 Punkten von früheren Arbeiten über dieses Thema: 1. handelt es sich fast ausschliesslich um Fälle von Nieren-Ureterensteinen. 2. wurde an fast sämtlichen Fällen systematisch die Urographie vorgenommen. 3. wurden fast sämtliche Fälle systematisch nachuntersucht.

Das Material umfasst 71 Fälle von Harnwegskonkrementen bei Kindern aus der Zeitspanne 1929—1943. Das Verhältnis Knaben : Mädchen erwies sich als 3 : 1. Die Altersverteilung war gleichmässig von 0 bis 14 Jahre. Die Dauer der Symptome vor dem Nachweis der Steine zeigt jedoch, dass nicht weniger als $\frac{2}{3}$ (im ganzen 41 Fälle) wahrscheinlich vor dem 5. Lebensjahre Steine gehabt haben, darunter 8 im 1. Lebensjahre und 25 in den ersten 3 Jahren. — Steinlokalisation: Das Material umfasst fast ausschliesslich Nieren-Ureterensteine und nur vereinzelte Blasen-Urethrasteine. Es unterscheidet sich hierdurch in entscheidender Weise von der Mehrzahl der früher veröffentlichten Materiale an Kindern, die vorwiegend Blasen-Urethrasteine umfassen. Spontaner Abgang von Steinen wurde bei 26 Patienten beobachtet und führte in 12 Fällen zu dauernder Rezidivfreiheit.

Die Bedeutung des Nachweises von Harnwegsanomalien wird hervorgehoben, besonders im Hinblick auf Prognose und Behandlung.

Therapie: 53 Patienten machten im ganzen 63 Operationen

durch. Primäre Nephrektomie wurde bei 7 Kranken vorgenommen, einfache Lithotomie bei 36, während 9 mehrere Eingriffe durchmachten.

Sehr bemerkenswert ist, dass 14 Patienten mit Ureterenstein operiert wurden, ein sehr hoher Operationsprozentsatz, der vermutlich dadurch zu erklären ist, dass viele spontan abgehende Steine nicht diagnostiziert werden.

Die Operationsmortalität ist gering: nur in 1 Falle sah man im Anschluss an die Operation den Tod eintreten.

Rückfallsfrequenz: Von 43 Nachuntersuchten (alle operiert) waren 34 rezidivfrei geblieben. Rückfälle kamen bei 9 Kranken (21 %) vor, was eine Rezidivfrequenz von 29 für Infizierte und 11 für Nichtinfizierte bedeutet.

Schlussfolgerung: Die Urolithiasis im Kindesalter dürfte wohl nicht so selten vorkommen, wie man es, wenigstens in Skandinavien, angenommen hat. Sie stellt eine Krankheit mit sehr wechselndem Verlauf dar. Im ganzen ist jedoch mit bedeutenden Schädigungen der Harnwege durch Steinkrankheit in denselben zu rechnen, weshalb die Operation unabhängig vom Alter anzuraten ist.

Résumé.

Le matériel présenté se distingue sur 3 points des travaux antérieurs sur le même sujet: 1) Il s'agit presque exclusivement de calculs réno-urétéraux; 2) l'urographie a été pratiquée systématiquement presque chaque fois; 3) des contrôles ultérieurs systématiques ont porté sur presque tous les cas.

Le matériel est constitué par 71 cas de calculs des voies urinaires, provenant de la période allant de 1929 à 1943. La proportion garçon-filles est de 3 à 1. L'âge des sujets se répartit d'une façon égale de 0 à 14 ans. Cependant la durée des symptômes avant la mise en évidence des calculs montre que pas moins des deux tiers des patients (41 en tout) ont probablement eu des pierres avant l'âge de 5 ans, et parmi eux 8 avant 1 an et 25 avant 3 ans.

Localisation des calculs: Le matériel est représenté presque exclusivement par des calculs réno-urétéraux, avec seulement quelques cas isolés de calculs vesico-uretraux. Il se distingue ainsi d'une façon décisive de la plupart des séries, concernant des enfants, publiées précédemment, où il s'agissait en majeure

partie de calculs vésico-uréthraux. L'expulsion spontanée de la pierre a été observée chez 26 malades, avec absence durable de récédive chez 12.

L'auteur souligne l'importance qu'il y a à reconnaître les anomalies des voies urinaires, en particulier au point de vue du pronostic et du traitement.

Traitement. 53 malades ont subi 63 opérations en tout. Une néphrectomie primitive fut faite chez 7 d'entre eux et une lithotomie simple chez 36, tandis que 9 furent soumis à plusieurs interventions.

Il est très frappant que l'on ait recouru à l'opération chez 14 malades ayant des calculs de l'uretère, ce qui est un pourcentage opératoire fort élevé qui vraisemblablement doit s'expliquer par le fait que beaucoup de cas à évolution spontanée ne sont pas diagnostiqués.

La mortalité de l'intervention est faible, on a observé qu'un seul décès postopératoire.

Fréquence des récédives: Sur 43 cas réexaminés (tous opérés) 34 étaient sans récédive. On trouva une récédive chez 9 sujets (21 %), ce qui signifie une proportion de récédives de 29 % pour les cas infectés et de 11 % pour les non infectés.

Conclusion: La lithiase urinaire de l'enfance n'est guère aussi rare qu'on le pense, du moins en Scandinavie. C'est une affection dont l'évolution est sujette à de fortes variations. Dans l'ensemble on doit cependant compter avec des dommages considérables causés aux voies urinaires comme conséquence de la localisation de la lithiase à leur niveau, de sorte que l'opération est à recommander sans égard à l'âge.

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Technique de la surrénalectomie et surrénal- ectomie pour le syndrome génito- adrénal pendant l'enfance.¹

Par

E. DAHL-IVERSEN.

L'anatomie chirurgicale des surrénales, spécialement pour ce qui concerne la vascularisation, laisse à désirer dans les articles existants sur la technique de la surrénalectomie. Les manuels d'anatomie ordinairement employés ne donnent également pas de renseignements à un point de vue chirurgical. En me basant sur les dessins et les renseignements concernant ces rapports donnés par GÉRARD dans son manuel d'anatomie humaine (1921), et en connexion avec la rencontre faite dans quelques dissections que le Dr. A. BERTELSSEN a entreprises pour moi dans la documentation d'autopsie, j'ai tracé le schéma ci-joint sur la *vascularisation* des glandes suprarénales (Fig. 1) telle qu'elle se présente le plus souvent. Le traitement du pédicule a été entrepris pendant les opérations en vue de ce schéma.

La *grandeur des surrénales* est connue chez les adultes mais, que je sache, pas chez les enfants, à part le poids (voir ROESSLE et ROULET) qui est de moindre importance pour le chirurgien. C'est une lacune d'autant plus grande que c'est surtout chez des sujets de cet âge-là qu'on peut être forcé d'opérer les surrénales en cas de syndrome génito-adrénal, aussi fait-on des recherches sur cet état. Les surrénales sont relativement plus grandes pendant les premières années de la vie que plus tard, car ce n'est qu'au bout de la 3^{me} année de vie qu'elles prennent leur forme définitive, leur position et relation avec les organes avoisinants.

¹ Conférence faite à la Société danoise de Chirurgie le 30/1 1944.

La relation entre les reins et les surrénales est ainsi de $\frac{3}{1}$ à la naissance et chez l'adulte $\frac{30}{1}$. Les dimensions des surrénales chez l'adulte sont soumises à d'assez grands écarts surtout pour ce qui concerne la longueur. Sur environ 70 et 50 mesurages, GÉRARD et GOLDZIEHER ont respectivement trouvé les valeurs moyennes suivantes pour les surrénales gauche et droite chez les adultes:

	gauche		droite	
longueur	5.0	5.0 cm.	4.5	4.9 cm.
largeur	2.5	3.2 cm.	3.2	3.3 cm.
épaisseur	8	9 mm.	7	9 mm.

La corticale est de 1 mm. et la médullaire 3 mm.

Les surrénales sont accolées d'une manière frappante à leur entourage, excepté dans leur relation avec les reins auxquels l'accollage est le plus souvent léger. Ce dernier fait est de signification pour l'intervention dans les surrénales, intervention qui exige une technique spéciale pour éviter le décollage de la surrénale du pôle supérieur pendant la dénudation de l'organe pour la résection surrénale ou pour la surrénalectomie.

La vascularisation des surrénales ressort de la Fig. 1. Si l'on considère d'abord les artères, on constate que l'artère principale est l'artère suprarénale inférieure qui part de l'artère rénale à proximité de l'aorte et qui se divise en deux branches marginales. Il y a en outre 2 branches artérielles qui vont à la surrénale: l'artère suprarénale médiane qui est souvent double et qui part de l'aorte. Elle se divise en un rameau antérieur et un rameau postérieur, les branches suprarénales supérieures qui comprend de nombreux rameaux de l'artère diaphragmatique inférieure. Ces branches aboutissent à la glande, de préférence le long de la partie latérale du bord interne. La voie veineuse se forme un peu différemment des deux côtés. Du côté droit les ramifications veineuses intraglandulaires se réunissent vers le centre de la surrénale, du côté gauche vers la partie inférieure du bord interne. Les veines suprarénales partent de ces deux points. Du côté droit, la veine est courte et aboutit au bord droit de la veine cave, du côté gauche, elle se réunit à la veine diaphragmatique gauche et aboutit comme veine suprarénale gauche dans la veine rénale gauche. Les rapports anatomiques produisent du côté gauche deux pédicules principaux qui doivent être liés à l'extirpation de l'organe. Quand on pénètre par la voie postérieure, ces pédicules sont placés en bas médialement et en haut plus

latéralement. Du côté droit se trouvent les deux pédicules correspondants, mais aussi le très court pédicule veineux sur la face antérieure qui fait qu'une extirpation de ce côté est très difficile et surtout risquée en raison de la fixation proche et assez forte de l'organe à la veine cave. On préfère entreprendre l'opération du côté gauche pour la surrénalectomie quand on a le choix entre les deux côtés.

On peut *aborder les surrénales* soit par une laparotomie, ce qui est un avantage en cas d'intervention pour une grande tumeur

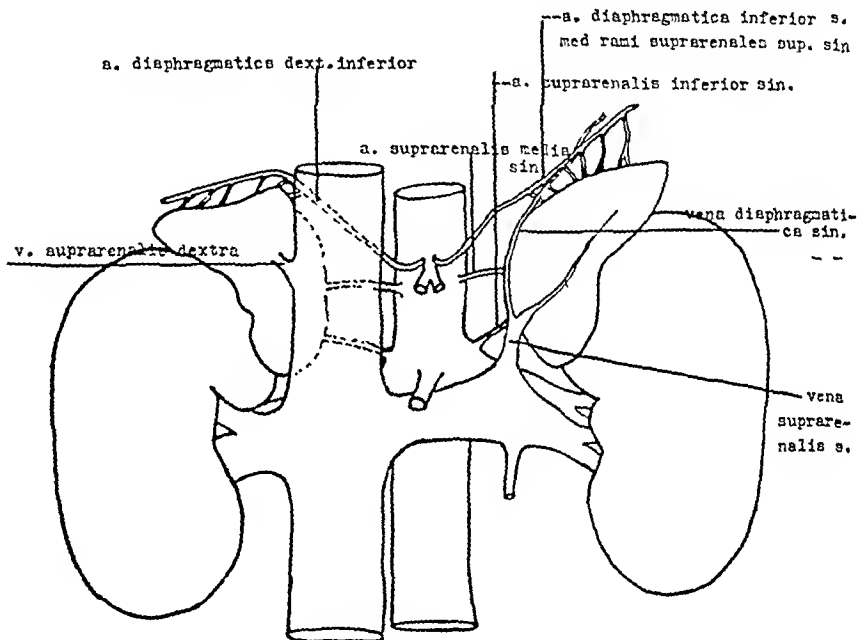


Fig. 1. Vascularisation des surrénales.

de la surrénale, soit par voie rétropérinéale. En cas d'intervention pour un syndrome hormonal sans base de tumeur, cette dernière voie offre de sérieux avantages. Dans deux cas, presumant une tumeur surrénale, j'ai abordé les surrénales par une laparotomie médiane supérieure et ai constaté qu'on ne peut, avec certitude, rien percevoir au palper de l'état des surrénales ni après avoir fendu le péritoine et la graisse de la paroi abdominale postérieure dans les cas sans tumeur surrénale mais avec hyperplasie. Dans l'intervention par voie antérieure on pénètre du côté gauche par le ligament gastro-côlique et, du côté droit, par le péritoine pariétal à droite du duodénum et du ligament hépatoduodénal. Par la voie rétropéritonéale on aborde généralement la surrénale par

la région lombaire, le malade étant couché sur le côté pour l'intervention unilatérale ou sur le ventre pour l'intervention bilatérale simultanée. Toutefois, on a aussi indiqué une voie antérieure parapéritonéale, le malade étant alors en décubitus dorsal. La technique est pareille à la méthode parapéritonéale pour la néphrectomie. Cette méthode-ci semble cependant être peu utilisée. La voie employée ordinairement est ainsi la lombaire à moins qu'il s'agisse de grandes tumeurs surrénales. Il y a indiqué ici différentes sortes d'incisions qui peuvent toutefois se réunir en deux: une incision lombaire haute le long de la 12^{me} côte ou le long du bord inférieur de cette côte, et une incision longitudinale juste latéralement au muscle sacrospinal. De ces incisions je préfère la première qui donne le meilleur accès à la surrénale. La dernière offre l'avantage qu'on peut, sans influencer le thorax, aborder les surrénales par une double incision. Le malade est en décubitus abdominal. Il me semble que cette double incision donne un accès suffisant pour un examen de la surrénale et faire la résection surrénale éventuellement bilatérale par une double incision simultanée, mais je la trouve insuffisante pour une surrénalectomie. L'incision verticale est surtout recommandée de côté américain. L'incision horizontale avec extirpation de la 12^{me} côte donne un bon accès et peut être entreprise simultanément des deux côtés, le malade étant en décubitus abdominal. C'est toutefois pour moi une question de savoir si on doit faire cette dernière intervention en une séance. Je l'ai entreprise deux fois en deux séances et sans accident, tandis que, dans le 3^{me} cas où j'avais opéré en une séance, le malade est mort 4 jours plus tard d'une atélectase pulmonaire diffuse et d'un oedème pulmonaire. La question est de savoir si cet accident est dû à l'extirpation simultanée des deux côtes XII, ce qui pourrait rendre la ventilation des poumons difficile.

Pour l'intervention unilatérale, le malade est placé sur un billot comme pour la néphrectomie. L'incision est faite le long du bord inférieur de la 12^{me} côte (voir la fig. 2). Elle comprend le derme, le tissu souscutané et la musculature superficielle, puis on dénude la côte XII et résèque jusqu'au processus transversal. On fend alors le tendon du transversus juste au-dessous de la côte en pénétrant latéralement. Le tendon fendu, on introduit le doigt et refoule le péritoine. Médialement on repousse soigneusement le cul-de-sac pleural vers le haut avec un doigt et le tient ensuite écarté avec un spéculum avant que le reste du ten-

don soit fendu sur le doigt qui y est introduit. On arrive maintenant à la partie supérieure de la loge rénale avec le fascia rétro-rénal qu'on isole médialement en arrière de la musculature, et latéralement et en avant du péritoine. Ainsi que nous l'avons dit, on protège le péritoine latéralement avec un spéculum, et avec un autre, on protège le cul-de-sac pleural médialement vers le haut. Ensuite on fend le fascia rétro-rénal verticalement et pénètre dans la loge rénale. La *dénudation de la surrénale* est la partie la plus délicate de l'opération. La meilleure méthode que j'ai trouvée est celle indiquée par BLEICHER et que la fig. 2, en

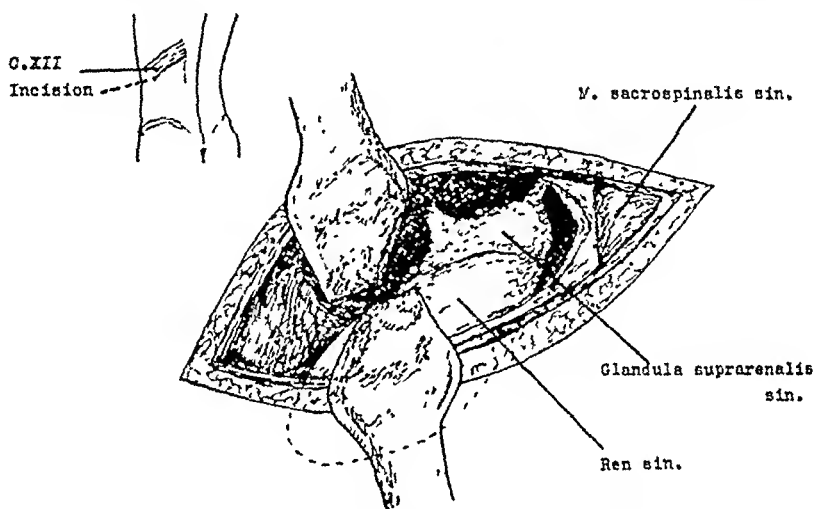


Fig. 2 Dénudation de la surrénale gauche par incision lombaire.

bas, reproduit. Après avoir ouvert la loge rénale, on dénude avec le plat de la main, en allant de l'extérieur à l'intérieur, la face antérieure du rein du fascia prérénal à la hauteur de la moitié supérieure du rein. Arrivé au bord supéro-médial du rein, on continue avec les doigts la dénudation répondant à la loge rénale aussi loin que possible dans le sens médial et vers le haut jusqu'au rachis. Toute la face antérieure de la surrénale est ainsi libérée et se présente bien. De plus, on garde la surrénale et le rein comme un entier. On embrasse bien le champ d'opération en poussant le fascia prérénal en avant et le rein en arrière (Fig. 2). Les *manipulations de la surrénale* doivent être faites d'une main très douce, car des manœuvres plus dures pourraient amener une forte baisse de la tension artérielle et un shock. De petites hausses de tension artérielle peuvent survenir même par une manipulation prudente.

Il manque encore l'*isolation de la surrénale*, c. à. d. de libérer sa base et sa face postérieure. Tandis que BLEICHER isole immédiatement la base, j'ai constaté que c'est un avantage de commencer par isoler la face postérieure du fascia rétro-rénal en allant de l'extérieur vers l'intérieur avec 2 doigts. Finalement on décolle la base de la surrénale du rein à l'aide des doigts ou avec des ciseaux non tranchants, car on travaille en contact avec le rein et dans le sens antéro-postérieur. La relation est ordinairement très lâche, de sorte que le décollement a facilement lieu trop tôt en connexion avec l'isolation des faces antérieure et postérieure. Le décollement du rein et de la surrénale étant faite, on pousse le rein latéralement vers le bas avec une serviette et un spéculum.

La surrénale n'a à présent de relation avec ses pédicules vasculo-nerveux que le long de son bord interne latéralement vers le haut et médialement vers le bas et, en outre, au milieu à la hauteur de l'artère suprarénale médiane. La surrénale proprement dite est entourée de graisse à travers laquelle se présentent de petites parties du tissu surrénal caractéristiquement coloré. Ce tissu est très délicat et c'est seulement sur les pédicules qu'on peut tirer. On commence par isoler et pincer le pédicule supérieur qui est long et étroit. Quand on y a posé les pinces, on peut, par la traction de la pince proximale, attirer la surrénale vers le bas et en arrière et, de cette manière, mettre à jour le pédicule inférieur qu'on pince également, mais juste à la surrénale ou à travers le coin de la surrénale s'il y a un pédicule très court. Si on ne s'en tient pas exactement à la surrénale, on peut facilement endommager les vaisseaux rénaux. Après avoir coupé ces deux pédicules il n'y a que celui du milieu qui tienne, répondant à l'artère suprarénale médiane. On le met à jour en tirant sur les pinces qui sont posées sur la partie glandulaire des deux autres pédicules. On lie ce pédicule à l'aide d'une aiguille à ligature de Deschamp juste sur le tissu surrénal, on coupe le pédicule et l'opération se termine après la ligature des deux pédicules principaux.

Le *procédé décrit* compte pour le *côté gauche*. Du *côté droit* il faut isoler et lier sur la glande la veine suprarénale qui part du centre de la face antérieure avant de commencer le traitement sus-nommé du pédicule. La veine se présente nettement à la dénudation de la face antérieure, décrite plus haut. La plaie de la paroi abdominale est refermée en étages. Quelques auteurs re-

commandent de poser un petit drainage de courte durée. J'ai refermé primairement et n'ai pas vu de complications.

En cas de *résection de la surrénale*, cette résection se fait en perforant la surrénale, p. ex. au milieu, avec l'aiguille de ligature de Deschamp armée de fil de catgut. On lie les deux côtés et extirpe ensuite la partie périphérique de la ligature. :L'opération est uni- ou bilatérale.

Avant d'opérer les surrénales, les deux doivent être examinées en vue d'une tumeur ou d'une hyperplasie, afin de ne pas faire une opération incorrecte ou du mauvais côté. Si la radiographie à vide et l'urographie intraveineuse, éventuellement en connexion avec une insufflation d'air autour du rein et de la surrénale, ne donnent aucun renseignement surtout en vue d'une tumeur, il n'y a que deux voies à suivre: 1° une palpation par devant par une *laparotomie médiane supérieure*, méthode que je trouve impropre pour une hyperplasie et peu sûre pour une tumeur, à moins qu'il soit question d'une assez grande tumeur; 2° une exploration des deux surrénales en une ou deux séances.

Dans l'*opération postérieure unilatérale*, de quel côté faut-il d'abord pénétrer? D'après les expériences existantes, le plus probable est d'aborder la tumeur du *côté gauche*, qui est aussi le côté par lequel nous avons pénétré.

Une condition pour la réussite dans une intervention dans les surrénales, à l'encontre d'autrefois, est un *traitement pré- et postopératoire* bien fait. A l'origine ce traitement a été mis en système à la clinique de Mayo et communiqué par KEPLER, WALTERS et PIPER en 1938. Comme l'extirpation d'une surrénale influe sur le *métabolisme des sels* (valeurs de potassium augmentées et valeurs de chlorure de sodium diminuées) on donne au malade, 2 jours avant l'opération, une nourriture pauvre en potasse (c. à d. sans pommes de terre ni pois) et riche en sel. Le *manque de cortex surrénal* influe également sur la résorption de la glucose dans le sens négatif et c'est pourquoi on donne une quantité abondante d'hydrate de carbone avant et après l'opération, ainsi que des produits corticaux parentéralement. La fréquence et la durée de l'administration des produits corticaux après l'opération dépendent des conditions de la tension artérielle et des électrocytes, mais on les administre au moins deux fois quotidiennement les premiers jours. La durée du régime diététique postopératoire dépend des conditions des électrolytes, du taux du sucre et de l'urée dans le sang ainsi que de l'équilibre de l'eau et du sel. Au

lieu de donner la glucose et le sel comme eau salée et glucosée ordinaire, additionnée de citrate ou de carbonate de soude par ingestion ou injection souscutanée comme on le recommande de côté américain, ROTHE MEYER et GÖRTZ l'ont administrée, dans le 1^{er} cas que j'ai opéré au *Dronning Louises Bornehospital* par ingestion comme une solution de 25 % de glucose plus du sel dans du jus de citron. Nous avons utilisé la même méthode dans les 2 autres cas provenant de la clinique des Enfants du Righospital et qui ont été opérés par moi à la clinique chirurgicale, mais on a administré en même temps de l'eau salée et glucosée immédiatement après l'opération. Nous avons administré préopérativement le matin et l'après-midi une ingestion de 60 grammes d'une solution de 25 % de glucose avec 1 gramme de sel dans du jus de citron. Le lendemain soir nous avons donné en outre intramusculairement 5 mgr. de percorten. La matin de l'opération on a administré la même dose de glucose et de sel plus 5 mgr. de percorten. Immédiatement après l'opération on a donné aux enfants 10 mgr. de percorten et $\frac{1}{2}$ litre d'eau salée et glucosée. En raison de l'expérience que nous avons acquise, nous conseillons toutefois d'administrer prophylactiquement 10 mgr. de percorten pendant l'opération, environ 20 minutes avant l'intervention dans la surrénale, car le *percorten agit* seulement au bout de 10 à 30 minutes. De plus, pour le shock nous faisons après l'opération une transfusion de sang et donnons de l'eau salée et glucosée en plus du percorten. Les 4 premières heures après l'opération il faut *en permanence* un *médecin* auprès du malade, et une *infirmière* les 4 premiers jours. La durée du *traitement postopératoire* et la quantité de percorten qu'il faut administrer dépendent, ainsi que nous l'avons dit, des conditions des électrolytes, du taux du sucre et de l'urée dans le sang, du pouls et de la tension artérielle, de même que de l'équilibre de l'eau et du sel.

D'après les principes mentionnés, j'ai opéré 4 cas dont deux avaient un syndrome génito-adrénal, et les deux autres un syndrome de Cushing dont l'un toutefois était peu net quant au diagnostic du syndrome de Cushing ou du syndrome génito-adrénal.

Il était question dans le *premier cas* d'un syndrome génito-adrénal, puberté précoce, chez une fillette de 4 ans. Elle avait un système pileux très fort sur les organes génitaux et son clitoris était hypertrophié à un pénis bien développé (voir la fig. 3). L'enfant n'a pas eu de menstruation. Objectivement on ne trouva

pas de précision pour une tumeur répondant aux organes génitaux internes, à l'hypophyse ou à la région rénale (urogrammes normaux). L'exploration était toute indiquée en vue d'une possibilité d'une tumeur surrénale. En décembre 1941 j'ai fait une *laparotomie médiane supérieure* afin de pouvoir résoudre le triple problème: l'examen des conditions des deux surrénales et de celles des ovaires. Il n'y avait pas de tumeurs dans les surrénales qu'on ne croyait pas grossies, mais on trouva toutefois que cette



Fig 3. Syndrome génito-adréнал, Puberte précoce.

estimation n'était pas sûre. Par cette incision on introduisit une main jusqu'au bassin et on crut constater que les ovaires étaient naturels quant à leur grosseur, leur forme et leur consistance. La palpation n'étant pas toute sûre, on fit une petite *laparotomie médiane inférieure* supplémentaire en inspectant directement les annexes également en vue de surrénales aberrantes. Les conditions étaient cependant normales. L'état postopératoire fut sans complications. L'analyse des hormones vers cette époque montra: gonadotropine 0, hormones oestrogènes 10—20, hormones androgènes 55. Ces valeurs sont normalement 0 à cet âge.

L'année suivante, les modifications dans les organes génitaux externes augmentant toujours, il était tout indiqué de faire un

examen plus satisfaisant des surrénales qu'il avait été possible de le faire par voie antérieure. L'opération se fit en deux séances, d'abord du côté gauche le $26/_{11}$ 42, puis du côté droit le $25/_{2}$ 43, suivie d'une surrénalectomie du côté gauche pendant la même séance. A la première opération du côté gauche, on trouva que la surrénale était grossie, mais on ne put percevoir au palper de tumeur dans la corticale ou la médullaire. Pendant cette palpation, la tension artérielle baissa de 130 à 95, mais remonta à 130 après une injection de 1 cm³ d'éphédrine. Puis on referma la plaie et administra de l'eau salée et une solution de bicarbonate. L'enfant avait subi un traitement préopératoire comme indiqué plus haut. L'état postopératoire fut bon. A la dernière opération, après le traitement préopératoire ordinaire, on pénétra dans le côté droit et constata que la surrénale était plutôt de grosseur naturelle pour l'âge de l'enfant et sans tumeur. L'organe n'avait que la moitié de celui du côté gauche à la première opération. On extirpa le coin latéral inférieur de la glande pour l'analyse microscopique après l'avoir liée par une ligature faite avec une aiguille à ligature de Deschamp. Il n'y eut pas de baisse de tension artérielle ou d'autre influence sur la tension. Après la fermeture de la plaie on aborda, pendant la même séance, le *côté gauche* et extirpa la surrénale qui s'était montrée fortement grossie à la 1^{re} opération. Il reste un peu de tissu surrénal à la ligature du pédicule inférieur, de sorte qu'il s'agit strictement parlant d'une *surrénalectomie subtotal*e. Pendant les manipulations et l'ablation de la surrénale gauche, la tension artérielle resta normale, mais 10 minutes après l'ablation, la tension tomba en une demi-minute de 140—120 —60 à 0. En même temps la malade devint bleu foncé avec la respiration superficielle. On administra dans le courant d'un quart d'heure 10 mgr. de percorten, 1 cm³ de sympatol 2 fois et $1/2$ cm³ d'adrénaline, après quoi le pouls redevint sensible et 10 minutes après, environ, la fillette était de nouveau rose et respirait normalement. La tension artérielle était cependant toujours basse et on lui administra de nouveau 10 mgr. de percorten et la tension remonta à 95—100 pendant la demi-heure qui suivit et resta là pendant les 12 heures suivantes. Ce n'est qu'alors que la tension artérielle remonta aux valeurs préopératoires vers 140—150. Le traitement postopératoire dura 9 jours dans ce cas et le cours fut sans complications. L'analyse des hormones le matin de l'opération montra: gonadotropine environ 17 U—R, hormones oestrogènes plus que 20 mais au-dessous de 200 U—S, hor-

mones androgènes 50 U—I par 24 heures. Six semaines après la surrénalectomie on trouva: gonadotrophine 0, hormones oestrogènes au-dessous de 20, hormones androgènes 9. Un mois plus tard les valeurs étaient: 0, 50, 20 et, 6 mois plus tard: 0, au-dessus de 20, 80. Si l'on compare une série d'analyses hormonales faites avant et après l'opération, il n'y a pratiquement parlant aucune différence. Cinq à six mois après l'opération, le système pileux du mont de Vénus commence à tomber, de même qu'il tombe quand on passe la main dessus. Le clitoris diminue. Ces derniers mois on a observé que le système pileux du mont de Vénus est de nouveau plus solide. En janvier 1944, on constate à l'examen qu'il est redevenu plus fort et solide. Le clitoris n'a pas augmenté. La mère me fait savoir qu'il y a un grand changement psychique chez l'enfant. Avant l'opération elle était irritable et emportée, tandis que maintenant elle est équilibrée et toujours de bonne humeur. Auparavant elle se fatiguait vite et s'étendait plusieurs fois par jour sur son lit où sa mère la trouvait endormie. A présent elle court et saute comme les autres enfants et est en mouvement du matin au soir. La fillette est à la hauteur de son âge et ne montre surtout pas d'intérêt sexuel vis-à-vis de l'autre sexe, comme elle n'en avait pas montré auparavant.

La *biopsie* prise à la *surrénale droite* montre une hyperplasie considérable d'un cortex plutôt normalement structuré. Le contenu de lipoïde semble légèrement diminué dans le cortex et la répartition de la lipoïde est irrégulière. Pas de fuchsinophilie. La *surrénale gauche* montre une hyperplasie corticale encore plus considérable que du côté droit, jusqu'à 9 mm. En outre, on voit juste en deça ou au delà de la mince capsule de tissu conjonctif qui entoure la corticale, des îlots de cortex ronds ou ovales ressemblant à des adénomes mais on ne trouve nulle part de plus grands adénomes dans les coupes. L'aspect de la corticale est comme du côté droit quant à la structure et au contenu de lipoïde. Pas de fuchsinophilie (GORMSEN).

Les 3 *malades* suivants ont été opérés à la *clinique C*. La *première*, une femme de 22 ans que j'ai opérée peu de temps après la première opération faite à l'enfant, souffrait du syndrome de Cushing mais, par une insufflation d'air périrénale du côté gauche, on avait trouvé une défiguration de l'ombre de la surrénale pouvant faire soupçonner une tumeur dans l'organe. Également dans ce cas-ci nous avons pénétré par une *laparotomie médiane supérieure*. On trouva les ovaires normaux, les deux surrénales sans

tumeurs palpables et ne paraissant pas hypertrophiées. Dans ce cas-ci on pensa que cette appréciation n'était pas sûre, même après qu'on eut fendu la cloison postérieure du péritoine pariétal et la graisse devant la surrénale. Nous ne pouvons donc, ainsi que nous l'avons déjà dit, recommander cette opération. Il ressort également de la bibliographie de ces dernières années que plusieurs auteurs trouvent l'appréciation incertaine au palper par la laparotomie.

C'est pour cette raison que dans le *troisième cas* on a choisi la voie postérieure simultanément des deux côtés d'après la méthode indiquée. Il s'agissait d'un garçon de 13 ans ayant un syndrome ressemblant tant au syndrome de Cushing qu'au syndrome génito-adréнал avec hyperplasie des organes génitaux externes et un fort système pileux de ces derniers. L'examen radiographique ne montra rien d'anormal à l'hypophyse et on constata des conditions objectives normales des gonades, de même que l'urographie intraveineuse montra des conditions normales. L'indication d'une opération était la possibilité d'une tumeur surrénale. L'intervention se fit le 11/3 43 à la narcose au protoxyde d'azote plus oxygène et éther. On trouva les deux surrénales uniformément grossies. Pas de formations d'adénomes palpables. Du côté droit on a pris un petit morceau pour l'analyse diagnostique, tandis qu'on a fait ensuite du côté *gauche* une *résection surrénale*, car on a conservé environ le tiers de la surrénale. A la palpation de la surrénale gauche, il survint une courte hausse de 25 mm. de la tension artérielle. La palpation de la surrénale droite donna une courte baisse de 40 mm., suivie d'une hausse de 30 mm. en connexion avec la prise pour la biopsie faite du côté droit. Avant de commencer la résection du côté gauche, on a administré 2 fois 10 mgr. de percorten à peu d'intervalle et 2 fois 1 cm³ de sympatol. Malgré cela, il survint en connexion avec la résection, une baisse de la tension artérielle de 180 à 100 — 90 à 0. La tension était environ de 175/105 avant le traitement préopératoire. Par l'administration de 20 mgr. de percorten, 1 cm³ d'oxédrine 2 fois et une transfusion de sang, on fit remonter la tension à 70—80 environ une heure après la fin de l'opération. Pendant les premières 24 heures on administra en tout 50 mgr. de percorten et c'est seulement environ 24 heures après l'opération que la tension fut la même qu'avant. Plus tard, il ne fut pas nécessaire d'administrer le percorten. Trois jours après l'opération il se développa un syndrome pneumonique bien que la recontre stéthoscopique

ne fût pas caractéristique; aussi le malade fut-il radiographié dans son lit, surtout en vue d'une possibilité d'atélectases pulmonaires bilatérales. En raison de l'agitation du malade, la radiographie fut si peu nette qu'on ne put l'apprécier, toutefois il ne sembla pas y avoir d'atélectases dans les poumons. Il fut traité à la chémithérapie. La mort survint à la fin du 4^{me} jour après l'opération. A l'autopsie on trouva une atélectase pulmonaire bilatérale aiguë et presque totale et un oedème pulmonaire. Dans l'hypophyse on trouva un petit adénoïme basophile dans la partie antérieure avec des modifications hyalines.

La microscopie du tissu surrénal des côtés *droit* et *gauche* extirpé à l'opération, montra une hyperplasie modérée de la corticale. Les cellules corticales sont assez remplies de lipoïde. Les modifications sont aussi prononcées d'un côté que de l'autre. On ne voit pas de granulations fuchsinophiles par la teinture de Ponceau. Dans la surrénale *droite* on trouva à l'autopsie par la microscopie une toute petite partie adénomateuse dans la corticale, entourée d'une capsule de tissu conjonctif bien développé, ce qu'on n'avait pas pu percevoir au palper pendant l'opération.

L'analyse des hormones faite immédiatement avant l'opération montra: gonadotropine 17 U—R, hormones oestrogènes environ 50 U—S, hormones androgènes 25 U—I, ce qui, pour ces deux dernières valeurs, est un chiffre élevé chez un garçon de 13 ans (HAMBURGER). L'analyse faite 3 jours après l'opération montra 0, moins de 7 U—S, 1 à 2 U—I par 24 heures.

Le *dernier cas* que nous avons traité est un garçon à peine âgé de 18 mois qui avait un syndrome génito-adrénal, puberté précoce. Il s'est développé normalement jusqu'à l'âge de 6 mois. A son hospitalisation, il est sommatiquement bien plus grand et lourd que pour son âge: taille d'un enfant de 3 ans, poids d'un enfant de 5 ans. Les organes génitaux externes grands et poilus. Les gonades sont de la grosseur d'un œuf de pigeon mais, à part cela, normaux, pas de tumeur.

La radiographie de la selle turcique ne montra rien d'anormal. Rien d'anormal également dans la région des reins au palper ou à l'urographie intraveineuse. En vue d'une possibilité d'une tumeur surrénale, on a entrepris une exploration des surrénales en deux séances, d'abord du côté gauche le 20/8 43 et du côté droit le 14/10 43, suivie d'une surrénalectomie gauche faite pendant la même séance. On ne trouva pas de tumeur du côté gauche, on avait l'impression que la surrénale était un peu grossie. Dans

l'autre opération, du côté droit, on vit que la surrénale n'était que la moitié aussi grosse que la gauche. Pas d'adénomes palpables. La tension artérielle n'a pas été influencée par la palpation des surrénales droite et gauche. L'enfant a été traité au préalable comme indiqué plus haut. Après avoir refermé l'incision du côté droit, on a fait, du côté *gauche*, une *surrénalectomie subtotal*e en conservant un peu du tissu répondant aux pédicules. Pendant l'ablation de la surrénale, il y eut assez courte hausse de 10 mm. de la tension artérielle mais, par contre, pas de baisse avec le shock. Après l'opération, on administra 200 cm³ d'eau salée et glucosée et le traitement postopératoire ordinaire. Le traitement postopératoire au percorten continua pendant les 3 premiers jours et put cesser. L'état postopératoire fut sans complications. La *microscopie* de la *surrénale gauche* extirpée montra à quelques endroits une épaisseur normale de la corticale et à d'autres, une hyperplasie. Le tissu de la corticale avait à quelques endroits l'aspect d'une involution postfoetale non achevée. Pas de formation d'adénome ou de formation de tumeur. Dans la corticale répondant surtout à la zone fasciculata on voit une dégénération adipeuse avec une fine vacuolisation du cytoplasma des cellules. Pas de fuchsinophilie. L'enfant a quitté l'hôpital au bout d'un mois. Pendant ce temps il n'y a pas eu de modification dans les organes génitaux et le système pileux.

L'analyse des hormones avant la surrénalectomie le $\frac{1}{8}$ 43 montra: gonadotropine 0, hormones oestrogènes 0, hormones androgènes 1—2 U—I, et le $\frac{18}{8}$: 4 U—I d'hormones androgènes. Onze jours après la surrénalectomie, le $\frac{25}{10}$ 43, l'analyse hormonale montra: 0.0 et les hormones androgènes environ $\frac{1}{2}$ U—I. C'est en janvier 1944 que nous avons eu pour la dernière fois des renseignements sur l'enfant. Le médecin nous a communiqué que:

Le système pileux des organes génitaux est aussi fort et étendu qu'auparavant mais que les poils ne tiennent pas et tombent quand on les tire légèrement avec les doigts. Le pénis et les gonades sont inchangés; il avait avant l'opération les bras et les jambes très poilus mais poils sont tous tombés. De plus, il y a une transformation évidente dans sa façon d'être. Avant l'opération il était violent, turbulent et bruyant, à présent il est calme et joue tranquillement. Son développement mental se fait rapidement depuis sa sortie de l'hôpital, ainsi il parle presque purement, tandis que lorsqu'il est rentré à la maison, il ne pouvait prononcer que quelques mots et des sons inarticulés.

Dans aucun des cas observés de syndrome génito-adrénal on n'a trouvé des tumeurs dans les surrénales comme étant la cause du syndrome mais, par contre, une hyperplasie des surrénales ou ceci en connexion avec un manque d'involution postfoetale. Faut-il faire dans de tels cas une résection bilatérale ou une surrénalectomie unilatérale? Si on trouve une hyperplasie uniforme des deux côtés, on fera l'opération la moins dangereuse qui est la résection bilatérale.

Par contre, si on trouve une hyperplasie unilatérale prépondérante, comme dans les cas présents de syndrome génito-adrénal, je pense que la surrénalectomie unilatérale est la juste opération si, dans l'entier, on doit intervenir dans un cas d'hyperplasie. Pour ce qui concerne ce dernier point, des examens ultérieurs plus approfondis que ceux qui existent dans la bibliographie seront décisifs. Nos cas n'ont pas, avec le temps d'observation existant, montré d'effets frappants du traitement, à part les changements psychiques que je n'ai pas rencontrés dans la bibliographie. Ceci concorde avec l'impression qu'on a en parcourant avec critique la bibliographie présente: que la résection ou l'ablation de la surrénale pour l'hyperplasie de cet organe ne produit pas d'effet ou seulement un effet passager sur les changements physiques.

Résumé.

Après une présentation de la vascularisation des surrénales et après une mention de leur grosseur, on donne un aperçu sur les voies d'accès aux surrénales. La voie la plus ordinairement employée est la lombaire. On recommande une incision de la 12^{me} côte en connexion avec sa résection. On parcourt la technique de la dénudation de la surrénale, son isolation et son extirpation. On décrit également la marche à suivre dans la résection uni- ou bilatérale. On fait ressortir que les deux surrénales doivent être examinées avant d'en faire l'opération, de même qu'on mentionne qu'il faut en premier lieu pénétrer du côté gauche dans l'opération en deux séances, car le plus probable est qu'on rencontrera une tumeur de ce côté.

On décrit le traitement pré- et postopératoire. La durée du traitement postopératoire dépend des conditions des électrolytes,

du taux du sucre et de l'urée dans le sang et de la tension artérielle.

On fait un exposé des points principaux des observations faites dans 2 cas de surrénalectomie gauche pour un syndrome génito-adrenal et une résection dans un cas de syndrome de Cushing non caractéristique cliniquement.

Dans les cas présents on ne trouve pas de tumeur dans les surrénales, mais une hyperplasie. Les deux malades ayant eu un syndrome génito-adrenal ont quitté l'hôpital et ont été réexaminés 11 et 3 mois après l'opération. Le troisième malade est décédé 4 jours après l'opération d'une atélectase et d'un oedème pulmonaires. L'autopsie a montré qu'il était question du syndrome de Cushing en raison d'un adénome basophile dans le lobe antérieur et non d'un syndrome génito-adrenal, ainsi que des signes du syndrome pouvaient l'indiquer.

On conseille de faire la résection bilatérale pour une hyperplasie bilatérale uniforme, tandis que pour une hyperplasie unilatérale prépondérante il faut probablement faire la surrénalectomie de la surrénale particulièrement hyperplasique si, dans l'entier, on doit intervenir pour un cas d'hyperplasie. Pour ce qui concerne ce dernier point, des examens ultérieurs plus approfondis que ceux qui sont communiqués dans la bibliographie seront décisifs.

Vu le temps d'observations qu'ils ont eu, nos cas ne montrent pas d'effets frappants du traitement, à part les changements psychiques vers le mieux, ce que je n'ai pas rencontré dans la bibliographie.

Summary.

Following a description of the arterial and venous supply of the suprarenal glands and mention of its size, the various approaches to the suprarenal glands are reviewed. The lumbar approach is the one most commonly used. An incision along the lower margin of the twelfth rib with resection of this rib is recommended. The technique with regard to the exposure, isolation and extirpation of the suprarenal gland is described. Likewise the method with unilateral or bilateral resection is presented. It is emphasized that both suprarenal glands must be examined before being operated on, and it is pointed out that the left side should be opened first

in two-stage operations, since the chances are greater of finding a tumor on that side.

The preoperative and postoperative treatment is outlined. The duration of the postoperative treatment depends on the electrolytes blood sugar, blood urea and blood pressure. The main observations made in two cases of left-sided epinephrectomy in genito-adrenal syndrome and one case of unilateral resection in clinically non-characteristic Cushing syndrome are presented.

The cases in question showed hyperplasia but no tumor in the suprarenal glands. The two patients with genito-adrenal syndrome were after-examined two and three months after the operation. The third patient died four days postoperatively of atelectasis and pulmonary edema. Autopsy revealed Cushing's syndrome due to a basophilic adenoma in the anterior lobe of the hypophysis and not a genito-adrenal syndrome, as the disease picture had suggested.

In homogeneous, bilateral hyperplasia, bilateral resection is recommended, while in principally unilateral hyperplasia, epinephrectomy of the particularly hyperplastic suprarenal gland should presumably be done, if any intervention at all is advisable in cases of hyperplasia. With regard to the last point, however, final judgement cannot be passed until more satisfactory after-examinations than those published hitherto have been conducted.

So far the two cases mentioned above have not shown any remarkable effect of the treatment, apart from mental changes for the better, that I have not found described in the literature.

Zusammenfassung.

Nach einer Darstellung der Arterien- und Venenversorgung der Nebennieren und Erwähnung der Grösse dieser Organe, wird eine Übersicht der für den Zutritt zu den Nebennieren infragekommenden Wege gegeben. Der am häufigsten eingeschlagene Weg ist der lumbale. Es wird zu einem Schnitt den unteren Rand der XII. Rippe entlang in Verbindung mit Resektion dieser Rippe geraten. Es wird die Technik inbezug auf die Blosslegung, Isolierung und Exstirpation der Nebennieren beschrieben. Auch das Verfahren bei ein- oder doppelseitiger Resektion wird wiedergegeben. Verf. betont, dass beide Nebennieren untersucht sein müssen, ehe ein Eingriff an denselben vorgenommen wird, und

erwähnt auch, dass bei zweizeitiger Operation zuerst die linke Seite in Angriff zu nehmen ist, da die Wahrscheinlichkeit, eine Tumorbildung zu finden, auf dieser Seite am grössten ist.

Die prä- und postoperative Behandlung wird besprochen. Die Dauer der Nachbehandlung hängt von dem Verhalten der Elektrolyte, des Blutzuckers, des Blutharnstoffes und des Blutdruckes ab. Es werden die wichtigsten Punkte von Beobachtungen gegeben, die an zwei Fällen von linksseitiger Epinephrektomie bei genito-adrenalem Syndrom und einem Falle von einseitiger Resektion bei klinisch uncharakteristischem Cushing'schem Syndrom gemacht wurden.

In den hier vorliegenden Fällen fand man keine Tumorbildungen in den Nebennieren, aber Hyperplasie. Die beiden Kranken mit genito-adrenalem Syndrom wurden entlassen und 2 bzw. 3 Monate nach dem Eingriff nachuntersucht. Der dritte Patient starb 4 Tage nach dem Eingriff an Lungenatelektase und Lungenödem. Die Sektion zeigte, dass es sich um ein Cushing'sches Syndrom infolge eines basophilen Adenoms im Vorderlappen der Hypophyse handelte, und nicht um ein genito-adrenales Syndrom, worauf gewisse Züge des Krankheitsbildes gedeutet hatten.

Bei gleichmässiger, beiderseitiger Hyperplasie wird eine bilaterale Resektion angeraten, während bei vorwiegend einseitiger Hyperplasie eine Epinephrektomie der besonders hyperplastischen Nebenniere auszuführen wäre, wenn man in Fällen von Hyperplasie nun überhaupt etwas vornehmen soll. Inbezug auf diesen letztgenannten Punkt müssen bessere Nachuntersuchungen, als sie im Schrifttum vorliegen, den Entscheid geben.

Unsere Fälle haben bei der verliegenden Beobachtungsdauer keine auffällige Wirkung der Behandlung ergeben, abgesehen von psychischen Veränderungen im Sinne einer Besserung, was ich in der Literatur nicht erwähnt gefunden habe.

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From the Mariestad Hospital, Mariestad, Sweden.
(Surgeon-in-chief: G. BAUER, M. D.)

Thrombosis Following Leg Injuries.

By

GUNNAR BAUER.

Every surgeon whose work has brought him into contact with fractures in the lower extremities has long been aware of the fact that these patients are especially subject to thrombo-embolic complications. It is, for instance, well known that a fatal pulmonary embolism often develops after fracture of the femoral neck or intraarticular fracture of the knee. The actual rate of incidence of these thrombotic manifestations, however, and the mortality and subsequent discomforts resulting from them, have not yet been studied in any detail.

Another relevant problem is the well-known phenomenon that while in some cases of fracture recovery is rapid, and the patients can return to their work without hindrance, in other cases which to all appearances are exactly similar there are serious after-effects, lasting over a long period, in the form of pain, swollen legs which will not return to normal, or other such discomforts. No completely satisfactory explanation of this has yet been found.

The general uncertainty with which this problem is surrounded is without doubt due to the fact that, for reasons to be enlarged upon later in this paper, the diagnosing of thrombosis, which is always a difficult matter, is especially difficult in the case of fractures and of other similar conditions. In fact, it is only since venography, the method of diagnosing thrombosis by the roentgen rays, has been made available that it has been possible to throw some light on the whole subject.

At the Mariestad Hospital, for several years, every case of thrombosis has been subjected to a thorough investigation, a venographic examination being one of the routine measures adopted.

The observations thus collected have been used in an endeavour to establish the part played by thrombosis in connection with leg injuries.

Frequency.

From material (1, 2) assembled from a number of countries, and comprising a great many cases, it is now possible to form a fairly good idea of the extent to which the thrombo-embolic disease occurs in the groups of patients among whom this complication has been found to be most frequent. Thus, table 1 shows that, after *surgical interventions*, one in every sixty patients is likely to get thrombosis; one in every six of these dies of pulmonary embolism. After *parturition*, thrombosis occurs in one woman in every hundred, and among the thrombosis cases one in twenty-five dies. Among *internal patients*, the incidence of thrombosis, contrary to what has previously been believed, is even higher than among those undergoing operations, seeing that one in every fifty patients must expect to get thrombosis and that among these one in five falls a victim to pulmonary embolism.

Table 1.

Incidence of thrombosis and mortality following thrombosis in different groups of patients.

	Incidence of thrombosis	Death rate from pulmonary embolism among thrombosis cases
After surgical operations	1.61 %	16.6 %
After childbirth	1.01 %	3.6 %
Among internal patients	2.1 %	19 %

As regards the group which is the subject of the present discussion, namely the *traumatic cases*, the literature does not contain anything like as detailed statistical information as that available on the other groups. Only a few reports give any indication that this aspect has received attention. A paper by VANCE (3), describing an investigation in New York for medico-legal purposes on fifty deaths following leg injuries, in which the cause of death was found to be thrombo-embolism, is of interest in this connection. It was found that this serious complication arose not only after severe types of fracture, but also after comparatively mild injuries.

In 11 cases, for example, it occurred after fracture of the tibia and fibula, in 2 after fracture of the tibia only, and in 7 after a simple fracture of the fibula. Even milder forms of injury were often sufficient provocation. Thus, in 5 cases there had been contusion or abrasion of the leg, in 3 a lacerated wound in the leg, in one a sprained ankle, and in one traumatic gonitis. It should be noted that in only *one* out of all these cases was the thrombosis diagnosed before the fatal pulmonary embolism developed.

As has already been pointed out, the reason for the lack of reliable statistical material on the incidence of thrombosis following injury would seem to be that it has previously been difficult to make a definite and objective diagnosis. At the Mariestad Hospital, however, over a period of three years from Oct. 1, 1940 to Sept. 30, 1943, the diagnosis has been verified by venography in all cases of thrombosis or of suspected thrombosis. A study of this material¹ which, although not large, has been carefully worked up, makes it possible therefore to reach a fairly correct conclusion on the part played by injury in provoking thrombosis.

During the above-mentioned three-year period 127 cases of thrombosis of the legs were treated at the Mariestad Hospital. This complication occurred:

after surgical operations	36 times
after childbirth or abortion	25 "
after fracture or traumatism in the legs	33 "
after treatment in bed for other reasons	25 "
in various other patients	8 "

Among the 127 patients in whom thrombosis developed 33 were suffering from traumatic conditions of the legs. *Thus, in a little over one-fourth of the thrombosis cases the disease arose after traumatism.*

The proportion appears still more striking, however, when comparisons are made between the numbers of patients in the different etiologic groups. It will be seen from table 2 that among 276 cases of leg injury there were no less than 33 cases of thrombosis, or an incidence of 11.9 per cent. On the other hand, the incidence of thrombosis among all the other groups of patients combined is as low as 1.04 per cent. *Thus, thrombosis was twelve times commoner among cases of leg injury than in all the rest of the material.*

¹ A detailed report on the material has been supplied in a previous article (4).

Table 2.

Thrombosis cases at the Mariestad Hospital during three years.

	No. of cases	No. of patients who got thrombosis	Incidence of thrombosis
Total no. of patients admitted .	9281	127	1.37 %
Traumatic conditions in lower extremities	276	33	11.9 %
Other patients	9005	94	1.04 %

A fourth column might therefore be introduced into table 1, headed thrombosis after injuries to the legs, and the incidence indicated as about 12 per cent. But the series presented in this paper is, of course, far too small to be compared with the very large series upon which the other figures in table 1 are based. In my opinion, however, there is not the slightest doubt but that future investigation will confirm that the proportions actually are as they have been indicated here.

As regards the *mortality* among untreated cases of post-traumatic thrombosis, there is nothing to be gained from a study of the Mariestad series as all the patients suffering from thrombotic conditions in the legs have been treated with heparin at our hospital. It is to be assumed, however, that if no special therapy is adopted the mortality among these patients will be hardly less than among patients submitted to surgical interventions and among internal patients, that is, about 15—20 per cent. Considering that there is such a high proportion of elderly patients among the fracture cases, however, an even higher rate of mortality is perhaps to be expected.

The Cause of the Frequent Occurrence of Thrombosis among Patients with Leg Injuries.

A study of the types of leg injuries giving rise to thrombosis yields certain features of interest (table 3). It will be observed from this table that the tendency towards thrombosis is great in patients suffering from fracture in the neck of the femur, an observation which tallies with the experiences reported by most investigators, and which in all probability is largely due to the high average age of these patients. The number of thrombosis cases is surprisingly low, on the other hand, among patients with such a serious injury as fracture of the femoral diaphysis, while after

breaks in the long bones of the lower leg or in the malleoli the incidence of the disease is fairly high. The greatest number of cases occur in connection with intra-articular fractures in the tibial condyles. Another striking feature is that fractures are by no means the only traumatic condition from which a thrombosis may arise. Injuries in the soft tissues such as lacerations, wounds, or even simple hematomas, are often sufficient to cause a high frequency of thrombosis; in the lower leg the proportion is no less than 18 per cent.

Table 3.

Thrombotic complications in patients admitted to the Mariestad Hospital for injuries to the thigh and lower leg during three years.

	No. of cases	No. of patients who got thrombosis	Approximate incidence of thrombosis
Fracture of femoral neck	47	7	15 %
Fracture of femoral shaft	25	1	4 %
Injuries in soft tissues of thigh.	30	4	13 %
Traumatic gonitis	43	3	7 %
Intra-articular fracture in knee.	19	4	21 %
Fracture in lower leg	52	5	10 %
Fracture in malleoli	25	3	12 %
Injuries in soft tissues of lower leg	33	6	18 %
Total	274	33	11.9 %

It is tempting to endeavour to draw conclusions, on the basis of these observations, as to the reason for the high incidence of thrombosis among patients suffering from leg injuries. The first obvious remark to be made is, of course, that almost all these patients were compelled to spend a period in bed and that this fact, according to universal experience, is one of the chief causes of thrombus formation. This can not be the only explanation, however, since if it were, the frequency of thrombosis ought not to be higher than that shown in table 1, or about 2 per cent at the most. Instead of this, we are confronted with a figure of 12 per cent among the traumatic cases. Further, if the stay in bed were the only decisive factor, it could be expected that the thrombosis would have occurred as frequently in the undamaged leg as in the injured leg. On the contrary, however, the experience at the Marie-

stad Hospital has been that, in all cases except one, the disease arose in the leg that had sustained the injury. There is every reason to believe that this was due to the fact that the injured leg, for various reasons, had been kept practically motionless. The plaster casts, the stretching apparatuses, various forms of bandages, and the pain caused by movement, no doubt all contributed towards this result. It should also be noted from table 3, however, that the occurrence of thrombosis — if the large number of fractures of the femoral neck, due without doubt to the high age of most of these patients, be left out of consideration — was much more frequent after injuries in the lower leg than it was in connection with similar conditions in the thigh. It will be found, if the case histories be studied closely, that in most instances it was a matter of large hematomas which had produced considerable swelling in the region surrounding the knee or in the upper part of the calf. In the case of the injuries in the soft tissues of the thigh, also, these were situated immediately above the knee joint and produced a similar, swollen condition. Thus, a common feature in all these cases was that there was a process which caused increased pressure in the soft tissues around the knee and had thereby brought about a greater or lesser degree of compression of the thin-walled and unprotected popliteal vein, or the upper parts of the deep blood channels in the lower leg. As a result, the flow of blood through the popliteal vein had become greatly impeded and a condition created for the formation of thrombosis exactly at the spot for which this disease shows a predilection in its beginning stages, the deep blood channels of the lower leg.

In my opinion, slowing of the blood flow from the lower leg is the most important factor in the production of thrombosis. The fact of having to lie in bed for any length of time, for whatever reason, causes a retardation in the blood flow, and results in a small number of thrombosis cases. In traumatic injuries in the knee joint region or in the lower leg the retarding effect reaches its height; the incidence of thrombosis is also multiplied many times over.

Diagnosis.

There is much evidence to show that in a great many cases thrombosis arising after injuries to the legs has hitherto failed to be diagnosed. Some intimation of this fact is provided, for example, by the previously-mentioned report by VANCE, in which it is stated

that among fifty cases of post-traumatic thrombosis only one was established by diagnosis while the patient was still alive. The same impression is gained from a study of the material from earlier years at Mariestad. During the ten-year period between 1923 and 1932, for instance, only one-eighth of all the cases diagnosed as thrombosis was described as being due to an injury to the leg. Now-a-days, since the introduction of venography, more than one-fourth of all cases of thrombosis are found to have this etiological basis. Mention can also be made here of an investigation carried out by the author in another connection (5). In 152 patients who had sought medical aid on account of swelling of the legs, or leg ulcers, it was possible to establish by venography that they had had a phlegmasia alba dolens in the leg many years previously. When an attempt was made to discover the conditions existing when these patients had had their thrombosis it was found that a great many of them could remember that the disease had arisen in connection with a fracture in the leg, but that an even larger number could not at first recall anything of this nature. It was only after a careful reconstruction of all relevant incidences that these patients could remember having had a fracture of the leg at an earlier period, spending a long time in bed, and having an extremely swollen leg when the plaster was removed, and having never since then been completely free from swelling and discomfort. In all probability, a post-traumatic thrombosis must have been present in these cases, although it had not been diagnosed when it was in the active stage.

It is important to understand exactly what happens when thrombosis following traumas is overlooked, as it obviously often has been in the past. To start with, we can say that a certain percentage of the fracture patients die from a sudden, unexpected attack of pulmonary embolism, an occurrence which is only too well-known. Among the others, the thrombotic process apparently passes through its customary stages, disguised by the general swelling and the hematoma formation in the leg, or under cover of the plaster bandage. When the patient is finally released from the plaster there may be no sign of anything indicating the presence of a thrombosis — except, perhaps, for a pronounced but unaccountable swelling of the leg which becomes accentuated when the patient is allowed to get up.

Although it is obvious that in patients who have sustained a fracture or a bad injury to the leg, the lower part of the leg is

generally swollen for one reason or another for quite a long period afterwards — this being generally due, in all probability, as will be discussed later in this paper, to angiospastic disturbances — I nevertheless feel convinced that the patients in whom the swelling is especially persistent have had an undetected thrombosis in this leg. This theory is based on my observations in connection with the chronic cases of thrombosis which have already been mentioned. It was often possible, on going through the past history of these patients, to reconstruct the entire course in a fracture case of the type in question, namely, one in which a predisposition to swelling and other discomforts had persisted after the break had healed and the plaster was removed. It could often be established that this swelling was nothing more nor less than the aftermath of thrombosis. In the manner typical of this disease the swelling had never totally subsided; on the contrary, if anything, it had become worse. Finally, as the years passed, other typical thrombosis sequelae had arisen in the form of brown, contracting indurations on the lower leg, and in many cases also the characteristic leg ulcers.

For the two reasons mentioned above, that is, to prevent sudden deaths from pulmonary embolism, and to hinder the appearance of post-thrombotic ailments, *it is of the utmost importance, therefore, that every attempt should be made to detect incipient thrombosis in traumatic cases*, in order that suitable treatment may be instituted. I admit, however, that it is often a difficult matter to make an early diagnosis in these cases.

The *general method for the diagnosing of thrombosis*, which has now been found to be satisfactory, has been described in previous publications (1, 6, 7). The diagnostic difficulties are even greater in the traumatic cases, however, than with other categories of patients. The temperature and pulse, for instance, are unstable during the period immediately following a trauma, and are not to be taken as reliable guides. Spontaneous pain can just as well originate from the actual lesion as from a beginning thrombosis, and in the same way swelling or pressure tenderness may just as well be caused by hematoma formation or lymphangitis as by thrombosis. Finally, all local observations are often difficult, or even completely impossible, for the simple reason that the leg is encased in plaster.

There is no infallible rule, in these circumstances, for being

sure of discovering every case of thrombosis at an early stage. The only thing to be done is to use one's judgment and powers of deduction, and above all to realize how common this complication actually is, and to be constantly on the look-out for it. One method which can be of great assistance in the uncertain cases is venography, which is even more valuable, for differential diagnostic purposes, in the posttraumatic cases than it is in the other groups of patients.

The diagnostic problems are illustrated to a certain extent by our experiences at the Mariestad Hospital. During the three-year period mentioned earlier in this paper 276 cases of leg injuries were registered. In 43 of these patients, such symptoms arose that the presence of thrombosis was either beyond all doubt or was to be strongly suspected. A closer study of the cases has brought out that in 22 instances the diagnosis left no cause for doubt. In 8 of them the whole leg presented the picture of a phlegmasia alba dolens, and in the other 14 the thrombotic process, when it was detected, was still confined to the lower leg but was nevertheless unmistakable. In practically all these cases a venographic examination was carried out, mainly for scientific reasons, but it can be said, however, that in none of them was venography *absolutely necessary* for the confirmation of the diagnosis.

In the remaining 21 cases the symptoms were all confined to the lower leg and were in addition so vague that it was not possible to decide with any degree of certainty, from the clinical observations alone, whether thrombosis was present or not. Venographic examinations were resorted to in all these cases and the results provided conclusive evidence. The presence of thrombosis was established in 11 instances; the patients were treated with heparin and soon became free from all their symptoms. As regards the remaining 10 patients the venograms were negative, and they therefore received no anti-thrombosis treatment. Nor did they develop any signs of the disease during the remainder of their stay in hospital.

In the material from the Mariestad Hospital, therefore, signs of thrombosis arose in not quite one-sixth of the cases of leg injuries. In half of these, thrombosis was definitely diagnosed on the basis of the clinical findings only. In the other half, the clinical signs were more uncertain, and it was only through the venographic examination that the diagnosis could be verified. It was proved by venography that in about half of the uncertain cases an incipient thrombosis was present; in other words, it was just at the

stage at which treatment can be instituted with the greatest chances of success. In the other uncertain cases there was no thrombosis, and the explanation of the clinical findings was therefore to be sought in some other cause.

It would be extremely interesting to make a closer investigation of the pathological conditions in a lower leg which can produce a syndrome so strongly resembling the one occurring in thrombosis. An analysis of the cases in question showed that in most of them the condition was due mainly to *angiospastic disturbances*, a fact which was confirmed by the rapid effect achieved by the blocking of the relevant sympathetic lumbar ganglia with novocain after all other therapeutic measures had been found to be ineffective. A more detailed account of various observations made in this connection must, however, be reserved for a later publication.

In view of the great risk of pulmonary embolism, or of the troublesome after-effects of thrombosis, it is in my opinion of such vital importance that a definite diagnosis should be made while the disease is still confined to the lower leg that there is *every justification*, if this complication is suspected, *for cutting a plaster bandage which has already been applied*, in order to make the leg accessible for a thorough clinical, and possibly also a venographic, examination. The risks involved in doing this are much less than if a case of thrombosis is left undiagnosed and untreated.

In the Mariestad series there were seven cases in which the presence of thrombosis was suspected while the injured leg was in plaster-of-Paris. In one instance there was no difficulty in diagnosing the condition because a phlegmasia alba dolens was already so manifest that there was no need to take a venogram. In one of the other cases the thrombosis appeared in the uninjured leg; this was the only case in which this occurred. In the other five cases it was necessary to cut the plaster; after this had been done a venographic examination revealed a thrombosis. The patients suffered no ill-effects from this measure. It was done by making an incision along the upper surface of the plaster bandage, and after the venogram had been taken the leg was replaced in the groove formed by the plaster, this being sufficient to fix the limb in the desired position. In one of the cases (a complicated tibia fracture) the position of the leg in the plaster had not been satisfactory from the start, and an osteosynthesis was to be done. The operation was delayed owing to the thrombosis but it was performed twenty days later, after the patient had received heparin treatment.

Treatment.

As in the case of all other types of thrombosis the post-traumatic variety can best be combatted by *prophylactic* measures. If it be

taken as established that the chief reason for the development of a thrombosis is a retarded return of the blood through the popliteal vein, then the most effective preventive measure will obviously be to raise the foot of the bed and to avoid the use of bandages, either of elastic or of other materials, which will constrict the region of the knee. It is more difficult, of course, to arrange for the patient to make suitable movements with the leg, but alternate stretching and relaxing movements can be made by the muscles even when the leg is attached to a traction apparatus or encased in plaster. Whenever possible, the patients should be allowed to get up, after the leg has been provided with a plaster bandage for walking purposes.

As regards the treatment with the specific agents now available for the combatting of thrombosis, heparin and dicoumarin, it might seem tempting to try prophylactic treatment with these preparations in the very group of patients in which the disease is particularly apt to occur, namely, the traumatic cases. Treatment of this kind, however, would meet with great difficulties, if only for the reason that it would have to be continued in many cases over a very long period of time. In patients with leg injuries involving a stay in bed, the period during which a thrombosis may arise extends over many weeks or months. In one of my cases, for instance, this complication did not occur until ninety days after the patient had sustained a complicated fracture of the femur. Furthermore, in the case of quite recent fractures, hemarthrosis, wounds, or hematoma, it seems possible that anti-coagulants might have a directly injurious action. It may be mentioned, however, that heparin, even when it was instituted as early as 2—3 days after the accident, did not have unfavourable effects in a single one of my cases.

As a rule, therefore, the treatment must be confined to cases in which the presence of thrombosis has already been established. The experiences with this form of treatment at the Mariestad Hospital are based wholly on what has been achieved with the use of heparin (Vitrum). This agent has, in fact, been found to be so excellent that experiments with dicoumarin were considered unnecessary.

Heparin treatment in post-traumatic thrombosis ought undoubtedly to be carried out along the same lines as those used for all other forms of incipient thrombosis. The regimen worked out at this hospital, and used without much variation by all hospitals

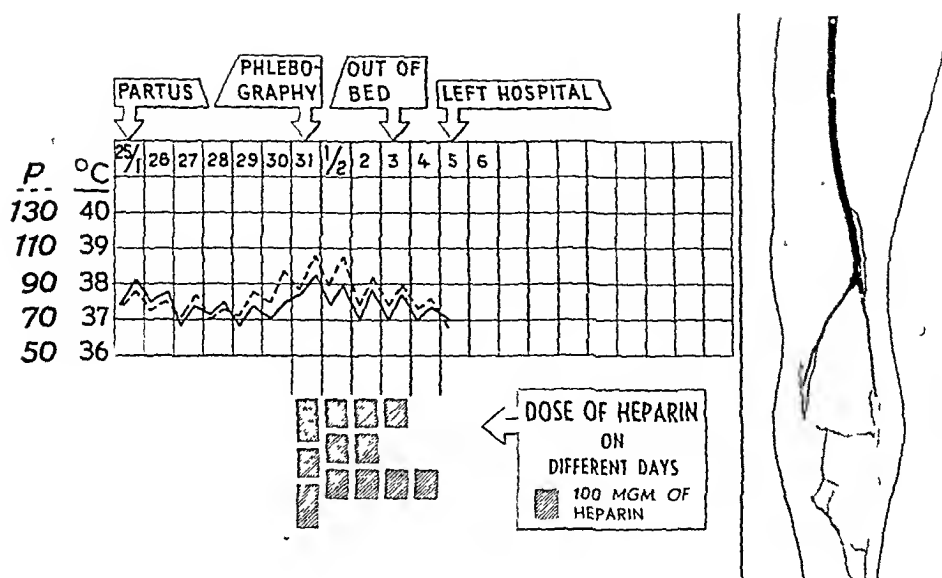


Fig. 1.

Example of typical abortive treatment with heparin. — In morning of sixth day after a normal partus a rise in temperature and pulse rate and slight tenderness on palpation over middle third of calf. *Venographic examination* (the picture to the right) revealed absence of contrast filling in deep blood channels of lower leg but a normally outlined femoral vein. Thus, a beginning thrombosis still confined to the lower leg. *Heparin treatment*: First day 150 + 100 + 150 mg. of heparin administered intravenously. Second and third days 100 mg. three times. After that, gradually reduced doses. Total dose, 1,300 mg. *Result*: On third day all tenderness had disappeared and temperature normal. Patient allowed to get up. On fifth day patient was provided with an Unna's paste stocking and discharged from the hospital.

in Sweden at which heparin treatment has been adopted, may be described briefly in the following manner. As soon as thrombosis (or pulmonary embolism) has been diagnosed 150 mg. of heparin is given immediately. Depending on the time of day when the diagnosis is made, one, or perhaps two, more doses of the same magnitude can be given, an interval of four hours being allowed to elapse between the doses. The last dose is given late at night. During the following few days three injections are given daily, a morning and an evening dose of 150 mg. and a midday dose of 100 mg. After a few days the temperature usually returns to normal (or to a few tenths of a centigrade above normal), and the swelling and pressure tenderness subside. The dose is then generally decreased, only two injections of 100 mg. daily being given, and on the last day the patient receives an evening dose only. The treatment is then at an end (see fig. 1).

In the majority of the thrombosis cases this heparin treatment takes between four and six days. After this time most of the patients can be allowed to get up; this is, in fact, one of the leading principles of the treatment, that the patients must be got out of bed at the latest on the last day the heparinization is in progress. The reason for this is to prevent fresh thrombi from forming when the protection provided by the heparin is withdrawn.

In one aspect only does the treatment of post-traumatic thrombosis differ from the method used for other forms of thrombosis. In the case of post-traumatic thrombosis, the patients can often not be allowed to get up when the thrombotic process, after 4—6 days of heparin treatment, is assumed to be cured. For obvious reasons, the plaster bandage or the traction treatment which the patient is undergoing must make this impossible in a great many instances. Under these circumstances, something has to be done to prevent the process from breaking out afresh, even though the patient is still lying in bed.

With this end in view, a method has been worked out at the Mariestad Hospital which might be termed *extended heparin treatment*. According to this method, when the return of the temperature and the pulse to normal, and the disappearance of the swelling and tenderness in the leg, indicate that the original thrombotic process is cured, the patient is kept going on small doses of heparin. As a rule, 100 mg. is given daily, in the evening, during the first few days. After a few days (2—6), this same dose is given every second day, and finally only every three days. After this dose has been repeated at three-day intervals a few times the treatment is discontinued (see fig. 2).

Seven cases of post-traumatic thrombosis have been treated in this way at Mariestad. In all cases except one the active thrombotic process was cured, clinically, after five days, on an average. After that period extended heparin treatment was continued for an average of twelve more days. The average total dose of heparin was 2,500 mg. In only one case, a bad comminuted fracture of the tibial condyles, was it necessary to extend the heparinization for as long as 23 days, the total dose being 6,300 mg. The result of the extended heparin treatment was fully satisfactory in all the cases. In no case was there the least sign of a recurrence of the thrombosis. One patient was even able to undergo an operative osteosynthesis two days after the treatment had been discontinued, without displaying any subsequent signs of thrombosis.

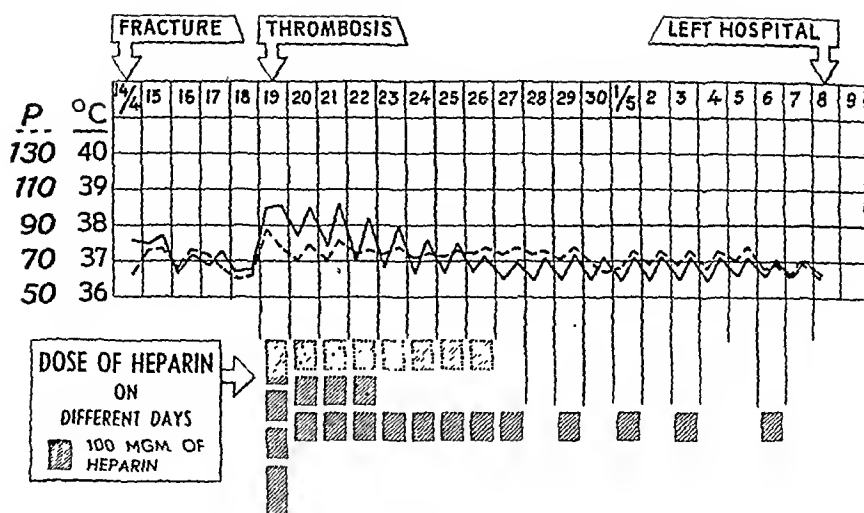


Fig. 2.

Example of extended heparin treatment in a patient who was not able to get up immediately after healing of the thrombosis. — Five days after a tibia fracture, a rise in temperature and pulse rate and clinical signs of thrombosis in lower part of injured leg. *Heparin treatment:* First day 150 + 100 + 100 + 150 mg. of heparin. After that, gradually reduced doses. By fifth day (Apr. 24) all local symptoms had disappeared and temperature was normal. Thrombosis obviously cured. Under normal conditions the patient would now have been allowed to get up. Owing to the fracture this was impossible. *Extended heparin treatment* was therefore given, with decreasing doses, on the first days in the morning and evening, then every two days, and finally every three days. Nineteen days after appearance of thrombosis all risk of a recurrence was considered to be over and the patient was discharged, with his leg still in plaster, to await healing of the fracture within the normal time.

The results of the treatment of patients with post-traumatic thrombosis with heparin, achieved at the Mariestad Hospital, can be summed up in the following words. During the three-year period embraced by the present investigation a total of 33 cases of this type of thrombosis were treated. There was one death. This was a 70 year old woman with a fracture of the femoral neck. Ten days after the accident a rapidly developing thrombosis in the leg was diagnosed. Heparin was administered immediately but she died suddenly of pulmonary embolism before it had had time to take effect. In all the other cases the heparin put an effective stop to all further signs of the thrombotic process. The disease never, in fact, spread further than the area it was involving at the time the treatment was instituted. In 26 of the cases the disease had not spread to the thigh and did not do so later. According to an investigation made by the writer in another connection (5), this means that in all probability all these patients would escape the post-traumatic

sequelae, such as swelling, indurations, and leg ulcers, which have been described in other communications and which only seem to appear when the thrombosis has involved the whole leg. In patients not treated with heparin, on the other hand, the thrombosis is known to spread from the lower leg to the thigh in about two-thirds of the cases.

Summing up, therefore, it may be said that during three years at the Mariestad Hospital, the treating of post-traumatic thrombosis patients with heparin has reduced the death rate due to pulmonary embolism from 15—20 per cent to 3 per cent; in other words, to one-fifth or one-seventh of what it was before, and that at the same time, among 26 cases, the probability of the occurrence of post-thrombotic after-effects was reduced to practically nil instead of its being likely that 17 or 18 of these patients would sooner or later become the victims of thrombotic sequelae. Finally, seven patients already had phlegmasia alba dolens at the time the treatment was started. These patients respond almost as promptly to intensive heparinisation as those with thrombosis of the lower leg. How the future prognosis appears for these patients is as yet not known.

Summary.

Investigations carried out at the Mariestad Hospital would indicate that thrombo-embolic complications occur after injuries in the lower extremities to a far greater extent than has previously been supposed. While the incidence of thrombosis is about 1.6 per cent after surgical operations, 1 per cent after childbirth, and 2.1 per cent among internal patients undergoing treatment in bed, the corresponding figure for patients who have sustained injuries to the legs goes as high as 12 per cent. Thus, post-traumatic thrombosis proves to be the commonest of all the different forms; actually a little over one-fourth of all cases of thrombosis would seem to have this etiologic background.

In practically every instance the disease occurs in the injured leg. The reason for the high incidence of the complication in this category of patients seems to lie partly in the total immobility of the damaged leg, and partly in a retarded blood stream in the popliteal vein due to hematoma formation, edema, or constricting bandages.

Until recently, there must without doubt have been a great many cases of thrombosis following leg injuries which have not been diagnosed, and consequently have received no treatment. It is quite possible for a thrombosis to become played out under a plaster-of-Paris bandage and only later make its presence known in the form of a persistent swelling and pains in the leg. Such symptoms appearing in the late stages of fracture treatment are often merely the precursors of a whole series of the typical post-thrombotic sequelae, swelling, indurations, and leg ulcers.

The diagnosing of incipient thrombosis in an injured leg is especially difficult owing to the fact that the specific signs of thrombosis are often drowned, as it were, in the symptoms resulting from the traumatic condition in itself. It should be realized that a thrombosis can be expected in one out of every eight patients, and that every suspicious symptom must be thoroughly investigated. If this is done, it would seem that about half of the thrombosis cases can be diagnosed by ordinary clinical examination. In the remainder of the cases, venography is of great value. This examination is of even greater differential diagnostic importance in post-traumatic thrombosis than in other forms of the disease.

The most suitable treatment for post-traumatic thrombosis seems to consist, in the first place, in prophylactic measures such as raising of the foot of the bed, and making the patient carry out movements of the leg muscles to the extent this is possible, and in the second place in the application of specific anti-thrombosis preparations.

The present investigation concerns only experiences with heparin. This agent should be administered according to the same rules as in all other types of thrombosis, but as some of the patients are not able to get up after the heparin therapy has been discontinued, an extended form of treatment must be adopted. With the aid of heparin the mortality from embolism after traumatism has been reduced, during a period of three years, to less than one-fifth of what it would otherwise have been, and in addition to this the probability that thrombotic after-effects such as swelling and leg ulcers might subsequently appear has likewise been considerably decreased.

Zusammenfassung.

In dem Krankenhaus Mariestad vorgenommene Untersuchungen scheinen darauf hinzuweisen, dass nach traumatischen Verletzungen der unteren Extremitäten thrombo-embolische Komplikationen in viel grösserem Ausmasse auftreten, als man es sich bisher vorgestellt hat. Während die Thrombosefrequenz nach chirurgischen Operationen etwa 1.6 % beträgt, nach Entbindungen 1 % und bei bettlägerigen innermedizinischen Fällen 2.1 %, scheint die Frequenz nach traumatischen Beinverletzungen auf etwa 12 % in die Höhe zu schnellen. Die posttraumatische Thrombose wird hierdurch die gewöhnlichste aller Thromboseformen sein: reichlich ein Viertel aller Thrombosen scheint tatsächlich diese Ätiologie zu haben.

Die Thrombose tritt praktisch immer in dem verletzten Bein auf. Die Ursache ihres häufigen Vorkommens scheint teils durch das strenge Stilliegen der verletzten Extremität bedingt zu sein, teils durch Blutströmungsschwierigkeiten in der Vena poplitea infolge von Hämatombildung, Ödem oder drückenden Verbänden.

Die Häufigkeit nicht erkannter und nicht behandelter Thrombosefälle bei traumatischer Verletzung des Beines scheint bisher sehr gross gewesen zu sein. Eine Thrombose kann sich sehr gut unter einem Gipsverband abspielen und erst später auffälliger Symptome in Form von zurückbleibender Schwellung und Schmerzen im Bein geben. Oft sind solche Symptome im Nachverlauf einer Frakturbehandlung nur die Einleitung zu einer charakteristischen Serie der gewöhnlichen postthrombotischen Symptome: Schwellung, Induration und Unterschenkelgeschwür.

Die Diagnose einer hinzugekommenen Thrombose in einem traumatisierten Beine bietet besonders grosse Schwierigkeiten, indem die spezifischen Thrombosesymptome oft in den durch die Verletzung an sich hervorgerufenen Symptomen sozusagen untergehen. Es ist notwendig sich darüber klar zu sein, dass man ungefähr in jedem achten Falle eine Thrombose erwarten kann, und seine Aufmerksamkeit auf jedes verdächtige Symptom zu richten. In dieser Weise scheint sich etwa die Hälfte der Thrombosefälle auf rein klinischem Wege feststellen zu lassen. In den übrigen Fällen leistet die Venographie unschätzbare Dienste, eine Untersuchung, die gerade bei posttraumatischen Thrombosen noch grössere differentialdiagnostische Bedeutung besitzt, als sonst.

Als zweckmässige Behandlung der posttraumatischen Thrombosen erscheinen erstens prophylaktische Massnahmen in Form von Hochlagerung des Fusses und Bewegungen der Muskulatur der Extremität in dem Masse, als die Verletzung es erlaubt, und zweitens spezifische antithrombotische Mittel.

Die hier vorgelegten Untersuchungen umfassen nur die mit Heparin gemachten Erfahrungen. Dieses Mittel ist in derselben Weise zu geben, wie bei jeder anderen Thrombose, da aber die Kranken nach beendeter Kur oft nicht aufstehen können, muss manchmal als Vervollständigung eine verlängerte Heparinbehandlung gegeben werden. Mit Hilfe von Heparin wurde die Sterblichkeit an Embolie nach Traumatismus in einer dreijährigen Zeitspanne auf weniger als ein Fünftel dessen heruntergedrückt, was sonst zu erwarten gewesen wäre, und ausserdem wurde die Wahrscheinlichkeit des Auftretens von Spätkomplikationen in Form von Schwellung und Unterschenkelgeschwüren sehr bedeutend vermindert.

Résumé.

De recherches faites à l'hôpital de Mariestad il semble ressortir qu'après les lésions traumatiques du membre inférieur les complications thrombo-emboliques surviennent dans une proportion beaucoup plus grande qu'on ne se l'était représenté jusqu'ici. Alors que la fréquence des thromboses après les opérations chirurgicales est de l'ordre de grandeur de 1.6 % environ, celle après les accouplements de 1 %, et celle des alités atteints de maladies internes de 2.1 %, le chiffre, après les lésions traumatiques de la jambe, bondit, semble-t-il, à quelque 12 %. La thrombose post-traumatique devient ainsi la plus répandue de toutes les formes de phlébite; largement un quart de l'ensemble des thromboses paraissent, en effet, ressortir à cette étiologie-là.

La thrombose se produit pratiquement toujours dans le membre blessé. La cause de son apparition si fréquente semble résider d'une part dans l'immobilisation particulièrement sévère de l'extrémité blessée, et d'autre part dans les difficultés circulatoires au niveau de la veine poplitee due à la formation d'un hématome, à de l'œdème ou à des bandages trop serrés.

La proportion des thromboses consécutives aux traumatismes de la jambe ni diagnostiquées ni traitées semble avoir été très grande jusqu'ici. Une thrombose peut très bien évoluer sous un appareil plâtré et ne donner des signes plus frappants que plus tard sous la forme d'enflure et de douleurs persistantes de la jambe. Souvent des symptômes de ce genre dans les suites du traitement d'une fracture ne sont que le prélude d'une série caractéristique d'autres symptômes post-thrombotiques ordinaires, tels que tuméfaction, induration et ulcères de jambe.

Le diagnostic d'une thrombose venant se surajouter à la lésion jambière traumatique offre des difficultés spécialement grandes parce que ses symptômes spécifiques sont souvent comme noyés dans ceux que donne la lésion traumatique elle-même. Il est nécessaire de se rendre à l'évidence qu'on peut s'attendre à une thrombose à peu près dans un cas sur huit, et de tenir son attention dirigée vers tous les symptômes suspects. De cette façon il semble qu'on doive pouvoir reconnaître par la simple observation clinique environ la moitié des cas de thrombose. Dans les autres la veinographie est d'une valeur inestimable, cette exploration ayant pour le diagnostic différentiel une importance encore plus grande dans les phlébites posttraumatiques que partout ailleurs.

Le traitement des thromboses post-traumatiques semble logiquement devoir consister, soit en mesures prophylactiques telles que position élevée du membre et mouvements de sa musculature pour autant que la lésion le permet, soit en application de remèdes anti-coagulants.

Les recherches rapportées ici ne comprennent que les expériences faites avec l'héparine. Ce remède doit être administré de la même manière que dans toute autre thrombose, mais comme trop souvent les malades ne peuvent pas se lever après la fin de la cure il faut parfois la compléter par l'adjonction d'un second traitement, prolongé, par l'héparine. Grâce à l'héparine la mortalité par embolie posttraumatique a été abaissée, pendant une période de trois ans, à moins d'un cinquième de ce qu'autrement les calculs auraient fait prévoir, en même temps que la probabilité de l'apparition de complications tardives sous forme d'œdème et d'ulcères de jambe a été très considérablement réduite.

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From the Surgical Department D. of Rigshospitalet, Copenhagen.
Chief Surgeon: Professor S. KJÆRGAARD, M. D.

Delayed Cholangiography and the Treatment of Overlooked Stones by the Pribram Method.

By

TYGE CL. GERTZ.

It is well-known that a good many cholecystectomized patients suffer from persistent pain of exactly the same character and localization as before the operation. Most follow-ups reveal complete recovery in 70—80 per cent of the patients, whereas 20—30 per cent have more or less pronounced complaints, one third of them so pronounced that the operative result must be described as poor. Let me mention a few recent Scandinavian statistics. Following up a material of 160 patients from Sundby Hospital in 1930, KJÆRGAARD found complete recovery in 70.6 per cent, 20.6 per cent not quite satisfactory, and 8.8 per cent poor. In a material of 260 cholecystectomized patients (all for cholecystitis) LIEBERG found complete recovery in 69 per cent, whereas 15 per cent had mild attacks now and then, and finally 16 per cent had recurrent attacks of colicky pains. Somewhat better figures were obtained by EHNMAR who in a material of 297 cases found complete recovery in 78 per cent, 14 per cent improved, and 8 per cent with grave recurrent colics. Finally, I have followed up the majority of the approximately 250 patients surviving from cholecystectomy in Department D. during the years 1934 to 1941 inclusive, and arrived at figures mainly corresponding to those found by KJÆRGAARD.

The rather moderate divergence between the figures of the above-mentioned and other reports presumably can be explained by a certain variation in the materials and their treatment (i.e. operative indications and technique), but on the other hand it is no doubt

due to a different estimation of the sequels which always to a certain extent must depend on a subjective judgment. Besides comprising regular, but mild attacks of colics, the group of "mild attacks" frequently is supplemented with various dyspeptic conditions which more or less justly are attributed to the operation. Conversely, the severe cases will be seen to comprise such conditions which presumably without the presence of a stone cause frequent and acute attacks of colics which are extremely uncomfortable to the patient and in his eyes make the operative result seem unfavourable. These attacks do not involve any danger, let alone menace to life, so from a surgical point of view the operation has not been a failure in the actual sense of the word.

In his fundamental work on the patho-physiology of the biliary tract WESTPHAL in 1923 suggested the term "dyskinesia", meaning a dysfunction of the neuromuscular apparatus, as an explanation of various lesions in the extra-hepatic biliary system. He did not, however, deal with the sequels of cholecystectomy, but other writers, inter alia TREPLIN, FLOERCKEN, and ZANDER soon took up his ideas to explain the recurrences of colics and consequently recommended choledochoduodenostomy or dilatation of the papilla in conjunction with the primary operation. But the proof of the fact that the majority of these relapses actually is due to dyskinetic conditions in the sphincter of Oddi has only been established by the investigations of recent years, chiefly by American authors (COLP & DOUBILET, WALTERS et al., BEST and MIRIZZI) partly by direct measuring of variations in the pressure withstood by the sphincter of Oddi during drainage, and partly by cholangiographic studies. Accordingly, not only the mild, but also part of the more severe cases, may be grouped under the heading of dyskinesia. Among other things this appears from the large number of reports of secondary operations, the only finding of which has been a more or less marked dilatation of the common bile duct. Apart from the rare stenoses, the most serious relapses, however, are due to overlooked stones. The presence of these stones is very regrettable, being a direct consequence of an inadequate operative technique and possibly involving a serious, even life-menacing condition.

It is of course impossible to obtain accurate information about how large a part of the poor end-results are due to overlooked calculi (genuine recurrences are presumably too rare to be taken into account), secondary operation (or autopsy) being the only

means of confirming it with any certainty. It must be borne in mind that only the most serious cases are submitted to secondary operation, so that the figure thus obtained must be regarded as a minimum.

LIEDBERG considers that one third of his poor end-results are due to overlooked stones, i.e. more than 5 per cent of the entire material. But he is positively certain only in 1.6 per cent of the cases. 9 out of EHNMARK'S 23 poor end-results were submitted to a secondary operation and stones were found in 7, i.e. 2.3 per cent of the entire material. Half of KJÆRGAARD'S poor endresults, i.e. 4.4 per cent, were due to overlooked stones. Among the above-mentioned material from Department D. I have up to this time only found one case in which the poor result was due to a calculus (revealed by delayed cholangiography). In further two cases delayed cholangiography has revealed overlooked stones. One of them has been symptomless to this day. Spontaneous passage is probable, but has not been observed. The other patient too has been well until recently. Her case history will be given below.

Of course it depends on the material, but also largely on the operative technique how often stones in the common duct are recognized and removed or on the other hand overlooked at the first operation. This very clearly appears from a report published by LAHEY. During the period from 1910—1926 he had only opened the common or hepatic duct to explore for stones in 15.5 per cent of his cholecystectomies and thereby discovered stones in 8.4 per cent of the cases. But during the period from 1926—1932 he had opened the common or hepatic duct in a total of 46 per cent and removed stones in more than 21 per cent of the cases. ALLEN and WALLACE have published similar figures, but not quite so striking. In Department D. the common and hepatic ducts have been investigated for stones in more than 50 per cent of all cholecystectomies during the abovementioned period, and 17.4 per cent contained stones. In his Sundby material KJÆRGAARD, however, found stones in the biliary ducts in 18.4 per cent by opening the common or hepatic duct in 33 per cent of the cases. Thus there seems to be a certain limit to how far one can get by this procedure alone. It must also be borne in mind that exploratory opening of the common or hepatic duct and removal of stones from the same by no means is a guarantee of an absolutely patent biliary tract as will appear from the following.

Cholangiography, immediate as well as delayed, has gained

increasing importance as a means to prevent the surgeon from inadvertently leaving stones behind. Immediate cholangiography of course is the ideal method, giving the surgeon information about the condition of the biliary tract during the operation and enabling him to take his precautions accordingly. But on the other hand it is technically more difficult, requiring a well established technique besides a powerful portable roentgen-ray unit. Delayed cholangiography may be performed with ease and comfort in the X-ray department and no doubt always gives the best pictures. As appears from the illustrations a successful cholangiogram reveals a fine filling of the common and hepatic ducts as well as the intra-hepatic biliary tree. The stones appear as filling defects, frequently of characteristic shape, corresponding to the often angular shape of gallstones. If there is free flow to the duodenum, which is the normal condition, although the sphincter of Oddi may offer a certain resistance, typical relief pictures are obtained of the duodenal mucosa. In case of a blockade in the common duct caused by an obstructing papillary calculus, a very characteristic defect may be seen in the lower end of the common duct, and of course there is no flow of contrast medium into the duodenum. Not infrequently the cholangiogram also reveals a contrast filling of the duct of Wirsung which must be interpreted as a sign of a well developed ampulla of Vater into which both ducts open and hardly involves any pathological significance apart from the fact that it probably chiefly is encountered in case of spastic conditions of the sphincter of Oddi.

In connexion with delayed cholangiography PRIBRAM has made the interesting suggestion to try to remove the overlooked calculi so demonstrated by dissolving them in ether injected through the drainage tube in the common duct. The fact that most gall-stones are soluble in ether may easily be confirmed by experiments in vitro, only pure pigment stones seem to be insoluble. Originally he conceived the idea after an operation on a desperate case of occlusion in the common bile duct with an obstinate cholemia. In this case he had been compelled to leave a concretion impacted in the papilla of Vater instead of removing the stone by the retro-duodenal or transduodenal route. By ether treatment he now succeeded in dissolving the stone and thereby curing the patient. Since then he has applied this procedure as a routine method in all cases of difficulties in removing calculi from the common duct, besides in a number of cases of persistent biliary fistula,

in which cholangiography through the fistula had revealed an overlooked stone as the causative agent. Up to the year of 1939 he had applied the method in a total of 38 cases, all with primary satisfactory result. The treatment, i.e. the dissolution of the stones, in many cases only took a few days, but in others it had to be extended over a period of up to 8 weeks before all the stones had disappeared. The dose suggested by him is from a few drops up to a couple of cc. according to the width of the common duct, repeated a few times daily. A weekly cholangiogram should be taken in order to control the result.

The PRIBRAM method does not seem to have been widely used. Since he published his first results some 10—11 years ago, only few reports have appeared, mostly of individual cases in which the procedure has been applied with or without success. ERKES has seen a favourable result in 4 cases. WALTERS has tried the method in 3 cases, the 2 with success. BASSET and PARSONS have each reported one case with a satisfactory result. BERNHARD and BEST both report that they have made several attempts without success. NICOLAYSEN and SMYTH have reported one case each without any effect whatever.

During the latter years delayed cholangiography has been applied in the majority of the drained cases in Department D. Let me add, that during the same period we have used drainage far more frequently than earlier and more rarely applied primary closure after our choledochotomies. This has been done in order to obtain the information afforded by a delayed cholangiography in as many cases as possible, and according to our experience drainage with a quite thin drainage tube in the common or hepatic duct does not prolong or complicate the post-operative course, if only the tube is clamped for a few hours daily from the first days in order that part of the bile may pass into the intestine. As a rule the tube is removed on the 8th—10th post-operative day, when cholangiography has been performed, and the fistula closes in the course of a few days. During the last year and a half immediate cholangiography has been performed in connexion with nearly all our gall-stone operations. I shall not, however, dwell further on our results from the latter method. At the outset we had some technical difficulties, which, however, have been surmounted, but our material is not yet sufficient to allow of a judgment.

Our contrast medium has in all cases been Hippodin (trade name for a 50 per cent solution of sodium ortho-iodine hippurate)

which as pointed out by HULTÉN among others, has the merit of mixing with the bile. It does not cause drop formation, the source of many erroneous interpretations when applying the oily contrast media which formerly were in use and still are to some extent. The amount varies somewhat, generally not more than 20 cc. In most cases the delayed cholangiography has revealed normal conditions and we have therefore been able to remove the drain with a clear conscience, but in a few cases we have discovered overlooked stones before the introduction of the PRIBRAM procedure.

In one case it was a question of an elderly woman who in spite of secondary operation still had stones in the hepatic duct. After having been completely well for 3 years she suddenly fell ill with constant pain in the right hypochondrium and iliac fossa accompanied by high fever. After admission to another surgical department a single examination revealed an icteric index of 48, and her condition was diagnosed as cholangitis. According to her own request she was transferred to Department D. a few days later. On admission no pronounced jaundice (index yet 22). Temperature normal, stools of a normal colour all the time. The syndrome was essentially marked by anuresis with uremia. Diuresis was only started after energetic treatment with diuretics and administration of fluid in large quantities. Thus there was no certain evidence of an occluded common duct or cholangitis, but most probably the uremia was hepatogeneous. Duodenal intubation at any rate still indicated the presence of a stone in the common duct as well as cholangitis. — In another case it was a question of a quite small stone in the position of the papilla. The patient has now been symptomless for more than 3 years, and the small stone has probably passed down spontaneously. — Lastly, a third case, an elderly woman, revealed a filling defect, somewhat larger than a pea, just above the papilla in the rather dilated common duct. The stools, however, being of normal colour both before and after the cholangiography, and duodenal intubation causing the flow of bile-coloured fluid, the drain was removed in the hope that the small stone would pass down spontaneously. A little more than a year after discharge this patient was re-admitted suffering from a violent jaundice which, however, subsided after duodenal intubation repeated a few times. It must therefore be taken for granted that the stone still was situated in the common duct. For nearly a year she has been well, without jaundice or pain, apart from one brief attack one month after the discharge from hospital.

During the last year and a half we have had occasion to try the PRIBRAM method in a series of cases, the reports of which are given below:

Case I. Obese woman, aged 33, admitted to the Department with violent jaundice following a severe attack of gall-stones a fortnight

earlier. Afebrile. The jaundice increasing, acholic stools and the onset of hemorrhagic diathesis complicating matters, an operation was decided on after 2 weeks' observation. The operation involved removal of a rather large gall-bladder packed with faceted stones, the size of a pea. 9 stones of the same appearance, were removed from the dilated common and hepatic ducts, whereupon further stones could not be extracted, and French bougies were forced into the duodenum, although with some difficulty. Drainage tube in the common duct. Before closing the wound cholangiography through the drain. The cholangiogram gave a suspicion of still a few stones in the common duct. It was, however, not considered advisable to prolong the intervention any further, all the more so as the cholangiographic finding was not quite certain. Delayed cholangiography a week later, however, revealed the presence of 12 stones in the common duct, besides some in the hepatic duct and no flow into the duodenum (Fig. I). After 8 days' ether treatment 4—5 of the original stones remained, besides a number of smaller fragments. After a continued ether treatment for one week all the biliary ducts were well-filled and devoid of stones, free flow into the duodenum (Fig. II). During the treatment the stools were searched for stones, but without any positive findings. The drain was now removed and the fistula closed in the course of a few days. One and onehalf years after discharge the patient stated that she was completely well.

Case II. Male, aged 62, transferred from a provincial hospital where he had stayed for 2 months with pain below the right curvature, fever attacks and varying jaundice. The diagnosis of cholelithiasis was substantiated by X-ray. At operation the gall-bladder was removed. It was the site of appreciable inflammatory changes and contained a couple of large stones besides some gravel. A number of stony fragments were emptied out of the common duct in a fluid of purulent bile. More large stones could not be extracted, and probes passed easily into the duodenum. Immediate cholangiography revealed a somewhat dilated common duct without filling defects; the hepatic duct and the intra-hepatic biliary ducts were not properly filled (Fig. III). Post-operatively almost decoloured stools. Delayed cholangiography a week later revealed a stone in the common duct, as large as the kernel of a hazel nut, which at all appearances must have descended from the hepatic duct after the operation (Fig. IV). Ether treatment was attempted twice, but had to be abandoned on account of the patient's general condition of exhaustion; still fever attacks complicated by a menace of hepatogenous uremia. At last bronchopneumonia supervened, and the patient died 5 weeks after the operation. The autopsy revealed a stone in the ampulla of Vater on the verge of penetrating its wall.

Case III. Male, aged 70, entered the hospital with high fever and mild jaundice which rapidly subsided. No present or past history of colics. During the following period still fever attacks and three weeks later again jaundiced, but stools not acholic. The jaundice being persistent an operation was decided on. Removal of a large, non-adherent

gall-bladder containing a number of calculi. The considerable dilated common duct contained clear bile without visible pus. A hazel nut-sized stone with some adherent gravel was removed from the duct and a stone of a similar size from the hepatic duct. These stones and none more had already been revealed by the immediate cholangiogram. Now probes could easily be passed into the duodenum, and further stones could not be extracted. Drainage tube in the common duct. Delayed cholangiography showed one large stone and a number of small filling defects in the common duct, but free flow of the contrast medium into the duodenum. Ether treatment for a week. A new cholangiography still revealed a few small filling defects. After a further 8-day ether treatment the drainage tube had become dislodged, so there was inadequate filling of the common duct. No filling defects could, however, be observed, so the drainage tube was removed. The fistula quickly closed. One and one-half years after the operation the patient is feeling completely well.

Case IV. Female, aged 28. For the last 5—6 years she had been suffering from typical biliary colics, frequently accompanied by mild jaundice of the sclerae, and acholic stools of brief standing. On admission quite mild jaundice, stools not acholic. Operation one week after admission with removal of a slightly distended gall-bladder containing numerous, pea-sized, faceted stones. Immediate cholangiography was a failure. More than 30 stones of the same type as those in the gall-bladder were extracted from the common and hepatic ducts which were as thick as a finger. After that probes passed easily into the duodenum. Further stones could not be palpated or extracted. Delayed cholangiography revealed the common duct dilated, its lower end interrupted by a typical excavation corresponding to a stone impacted in the papilla. At least 3 filling defects were observed in the hepatic duct, and the intrahepatic biliary ducts were not patent. No flow of fluid into the duodenum. Attendant acholic stools. Ether treatment which had to be continued for as long as two months, before the biliary tree with any certainty could be pronounced free. Quite special difficulty was experienced in the endeavour to fill the ducts going from the left branch of the hepatic duct, but as no calculi were visible, it was considered warrantable to discontinue the treatment. The occlusion might be due to a plug of mucus or edema in consequence of the constant irritation from the ether. After removal of the drainage tube the fistula closed in a few days. During the treatment the stools now and then contained soft stony fragments, but no whole calculi. During the one year which has passed since her discharge, she has had no symptoms of biliary lesions.

Case V. Female, aged 49. For about one year suffering from biliary colics increasing in frequency, but never associated by jaundice or fever. Surgical removal of a large gall-bladder, filled with stones. There being a number of small stones in the dilated cystic duct, the common bile duct was explored in spite of the negative anamnesis. The common duct was slightly dilated, but easily permeable to probes, no stones could be extracted. The immediate cholangiogram not being a success,

a drainage tube was inserted into the common duct with a view to a subsequent delayed cholangiography. The latter revealed good filling of the duct, but no flow into the duodenum. Just above the papilla there was a stone as large as a lentil (Fig. V). Ether treatment. The first injection caused immediate sharp pain, followed by the sound of violent bubbling as the pain subsided. The following injections did not cause nearly as much distress. I, therefore, think that the calculus may have been ejected simply by the pressure of the ether vapours already at the time of the first injection. A week later, at any rate, there were completely normal conditions (Fig. VI) and the drain was removed. A short time after her discharge from hospital the patient, who was of a rather nervous disposition, developed persistent, recurrent attacks of colics, without fever or jaundice, for which reason she recently entered a provincial hospital. These attacks in all probability are of a dyskinetic character.

Case VI. Female, aged 40. For about 16 years attacks of biliary colics with increasing frequency. Never jaundiced, but several times febrile for 1—5 weeks at a time. On admission afebrile, no jaundice, but increased urinary diastase (600). Surgical removal of a small, indurated gall-bladder without concretions. The common duct was dilated to the thickness of a thumb and was found to contain a somewhat soft, hazel nut-sized calculus which was removed. After that probes up to No. 20 F. could be passed into the duodenum, and the common duct was believed to be patent. This belief was further corroborated by a fairly good cholangiogram which only revealed a filling defect in the position of the removed stone. Delayed cholangiography, however, revealed a bean-sized concretion in the lower end of the common duct besides a number of minor filling defects of a doubtful character. Ether treatment extended over a period of more than 5 weeks. On control cholangiograms the calculus seemed to have been somewhat reduced and on the last film it appeared to have been split up in fragments. At this juncture the drainage tube unfortunately became dislodged, so further treatment had to be abandoned. The fistula rapidly closed and during the first few months after her discharge at any rate she has been well, without pain, fever, or jaundice. — This patient was greatly embarrassed by the ether treatment. She had violent attacks of colics which, however, were somewhat relieved on simultaneous inhalation of amyl nitrite. Once the treatment involved violent increase in the urinary diastase (1200) with simultaneous left-sided pain indicating a pancreatic reaction. The attacks subsided after the treatment had been suspended for a few days.

Case VII. Female, aged 36. 9 months ago temporary, dull, aching epigastric soreness, but never regular colics. One month before the admission to hospital she became jaundiced with associated acholic stools and choluria, but without any characteristic pain. Fever about 39 centigrade. Initial hemorrhagic diathesis was treated with vitamin K. Surgical removal of a thickened, edematous gall-bladder containing no stones. The common bile duct was considerably dilated, thick-walled

and contained a slightly bile-coloured, slimy fluid (beginning "white" bile). One calculus, as large as a date stone and another, the size of half a pea, were removed from the hepatic duct. But in spite of energetic attempts no stones could be extracted from the lower end of the common duct. The papilla was not with any certainty permeable to probes. Choledochoduodenostomy or transduodenal choledochotomy were contemplated, but trusting the PRIÉRAM method and taking the general condition of the patient into account, we were content with inserting a drainage tube into the common duct. Regrettably it was impossible to apply immediate cholangiography, the common duct having suffered a minor lesion, when the gall-bladder was mobilized. Delayed cholangiography revealed an obstructing stone, nearly as large as an almond, in the lower end of the common duct. During the following 6 weeks ether treatment was attempted in doses of up to 10 cc. at a time. Cholangiographic control, however, still revealed an almost unchanged condition, so at last a secondary operation became inevitable. The stone had to be removed by the transduodenal route, it being impossible to get hold of it from above. Uneventful convalescence. A new cholangiogram now revealed normal conditions, apart from a rather moderate dilatation. Although somewhat slowly, the removed calculus did dissolve in ether *in vitro*. 6 months after discharge she was seen in the Department and reported to be completely well.

Case VIII. Male, aged 54. For many years suffering from attacks of biliary colics, once, 12 years ago, associated with jaundice. During the latter years often fever and chills in connexion with the attacks. Lately intermittent fever and slight jaundice indicating a cholangitis. Surgical removal of a very considerably distended gall-bladder with slight inflammatory changes. Calculi could not be extracted from the somewhat dilated common duct. The papilla was easily passable to probes. The immediate cholangiography showed a somewhat deficient filling of the common duct without demonstrable filling defects. No filling of the hepatic radicals, no flow into the duodenum. Delayed cholangiography, however, revealed a hazel nut-sized calculus in the common duct, just above the papilla. Judging from the operative finding, it must have descended after the operation. Besides, there were some pea-sized, more doubtful filling defects in the right hepatic branch. The patient received only a brief ether treatment which caused brief, very violent pain which, however, was somewhat relieved by inhalation of amyl nitrite. In part the experience from the last case made it doubtful, whether the very large calculus would yield to the treatment, and in part it was not considered advisable to run any risks on account of the cholangitis. About 3 months later a secondary operation was performed. Even now it was unfortunately impossible to remove the large calculus which presumably by the placing of the patient in the Trendelenburg position (again?) had slipped up into an intra-hepatic bile duct, where it could be reached by the finger-tip. In spite of energetic attempts, partly applying forceps, scoops, and suction tube, and partly applying the anti-Trendelenburg position, it proved impossible to extract the



Fig. 1.

Fig. 2.

Fig. 3.



Fig. 6.



Fig. 5.

Fig. 4.

calculus from its present position. In order to be sure not to leave any stones behind in the common duet, transduodenal choledochotomy with longitudinal division of the sphincter was performed. After the second operation a renewed brief attempt was made with the ether treatment, but the calculus remained unchanged in size as well as location. In the meantime the small intra-hepatic filling defects had disappeared. Rather more than 3 weeks after the operation the drainage tube was removed. Contrary to the first operation there was now no persistent fistula. Recently the patient was discharged in good health. It is too early yet to form an opinion of the permanent result.

Apart from the second case in which it cannot be considered out of the question that the delayed cholangiography as well as the ether treatment may have been conducive to the fatal outcome in the case of the extremely exhausted patient (he could hardly have tolerated a new intervention with a view to remove the overlooked stone), we have not seen any detrimental consequences of cholangiography or ether treatment. The temporary pancreatic reaction which occurred in one case presumably was of no significance. But undeniably the ether injections in several cases caused rather severe pain which, however, always was of a transient character and as a rule could be palliated by simultaneous inhalation of amyl nitrite and by letting the ether vapours out of the drainage tube. As apparent from the above our experience does not justify an optimism like PRIBRAM'S, but still we think that the procedure in certain cases is of indubitable value and that it always should be attempted, before exposing the patient to the far greater risk of a new surgical intervention. No doubt it is wise first to test the ether solubility of the stones from the same patient in vitro. Should any conclusion be derived from our rather few cases, it would be to the effect that, according to expectation, small stone, even in large numbers, give the best prospects of a favourable result. In case of cholangitis some reservation no doubt is appropriate, but otherwise there are hardly any counter-indications.

It must appear peculiar that we have had so many cases of stones inadvertently left behind in the course of a comparatively short space of time. The fact is that during this period we have had an unusual number of severe cases of common duet stones, comprising, as apparent from the case histories, very mobile calculi which have lodged intrahepatically in inaccessible positions in order later to descend and obturate the common duet (let me emphasize that intra-hepatic stones may cause great, possibly

insurmountable difficulties). Furthermore, trusting the PRIBRAM method, we have deliberately left stones behind in a few cases rather than increase the operative risk by so radical an intervention as we otherwise would have felt compelled to perform. The rôle played by accidental circumstances appears from the fact that, as already mentioned, we have only found quite few certain cases of stones inadvertently left behind among the material followed up to this day.

Still we think that our material gives occasion to advocate drainage as the normal procedure after choledochotomy with a view to delayed cholangiography, not only following choledocholithotomy, but also in cases where choledochotomy has been performed by reason of a suspicion of stones, without any having been found. Some no doubt would think that the immediate cholangiography should render these precautions superfluous. According to our experience this is not so, which, however, may be due to the fact that our immediate cholangiograms have not always been a success. RUDSTRÖM, however, recently published a material of 241 operations for gall-stones, all with application of immediate cholangiography. In 61 cases there were co-existent common duct stones. 9 of the last-mentioned cases died primarily and at autopsy 5 revealed overlooked stones or stony fragments. 4 died later, all of cholangitis and in 2 overlooked stones were found to be the causative agent. Lastly, one was submitted to a secondary operation involving the removal of 8 calculi from the common duct. In all probability a delayed cholangiography would have revealed the stones left behind and secured the correct therapy in time, at any rate in the 2 cases of secondary deaths. As mentioned above, the inconvenience caused by a brief period of drainage is minimal, especially if one is careful to shunt the bile down into the intestine by an early clamping of the tube. The prothrombin activity, however, probably should be controlled. It is an open question whether even other reasons do not make drainage preferable to primary closure which frequently cannot become quite tight and, although only very exceptionally, may give rise to cholangioses and other dangerous conditions.

Summary.

The author reports 8 cases of overlooked calculi in the common and hepatic ducts, revealed by delayed cholangiography. In 6

cases the finding was a surprise, whereas the possibility had been considered in 2 cases. All the cases were treated by the PRIBRAM method, ether injection through the drainage tube to the common bile duct. In four cases the procedure resulted in the dissolution and expulsion of the stone. The stones in these cases were of a size up to a pea, in 3 cases multiple. In one case the drainage tube became dislodged before the treatment had been finished. In 3 cases of solitary stones, as large as a hazel nut or larger, the treatment was of no effect. 2 of them underwent a secondary operation and the third one, an elderly man with a severe cholangitis, died of bronchopneumonia. It is doubtful whether the ether treatment has had anything to do with the fatal outcome in this case, but still it urges to a certain reservation in case of cholangitis. Other untoward effects of the ether treatment have not been observed. The PRIBRAM method, therefore, is to be recommended in case of small stones, and presumably should be attempted with larger stones as well, provided they are soluble in ether, which should be ascertained beforehand by experiments with stones from the same patient in vitro. — The author recommends the combination of immediate and delayed cholangiography, not only in cases of common duct stones, but also in cases of choledochotomy for suspected stones in the biliary ducts.

Zusammenfassung.

Verf. teilt 8 Fälle von zurückgelassenen Steinen im Choledochus-Hepaticus mit, die bei sekundärer Cholangiographie entdeckt wurden. Bei 6 der Fälle war der Befund eine Überraschung, während man bei 2 auf die Möglichkeit vorbereitet war. Sämtliche Fälle wurden ad modum Pribram mit Äthereinspritzungen durch die Choledochusdrainage behandelt. In 4 Fällen führte dies zu Auflösung und Ausstossung der Steine. Es handelte sich hier um Steine von bis Erbsengrösse, in 3 Fällen multipel. Bei einem Falle glitt das Drän hinaus, ehe die Behandlung abgeschlossen war. In 3 Fällen, wo es sich um einen solitären Stein von Haselnussgrösse oder mehr handelte, versagte die Behandlung. Zwei derselben mussten erneut operiert werden, und der dritte, ein älterer Mann mit schwerer Cholangitis, starb an Bronchopneumonie. Ob die Ätherbehandlung bei diesem Todesfall irgendwie mitgewirkt hat, dürfte als zweifelhaft anzusehen sein, doch mahnt dieser Fall zur Zurückhaltung bei Fällen von Cholangitis. Im

übrigen wurden keine nachteiligen Folgen der Ätherbehandlung beobachtet. Die Methode Pribram's kann also in Fällen mit kleinen Steinen empfohlen werden und dürfte wohl auch bei grösseren Steinen zu versuchen sein, vorausgesetzt, dass die Steine ätherlöslich sind, wovon man sich immer durch Versuche mit Steinen desselben Patienten in vitro überzeugen muss. — Es wird die primäre Cholangiographie mit einer sekundären zu kombinieren, und zwar dazu geraten, nicht nur bei Fällen von Cholechoolithiasis, sondern auch, wenn die Choledochotomie auf Grund eines Verdachts auf Stein in den tiefen Gallenwegen vorgenommen wurde.

Résumé.

L'auteur rapporte 8 cas de calculs laissés dans le cholédoque et l'hépatique, qui furent découverts par la cholangiographie secondaire. Dans 6 des cas cette découverte fut une surprise, tandis que dans 2 on s'attendait à cette possibilité. Tous ces cas furent traités à la façon de Pribram par des injections d'éther au travers du drain cholédocien. Cela conduisit dans 4 cas à la dissolution et à l'élimination des calculs. Il s'agissait ici de calculs atteignant la grandeur d'un pois, et trois fois ils étaient multiples. Dans un cas le drain tomba avant la fin du traitement. Dans trois autres, où l'on était en présence de calculs solitaires du volume d'une noisette et au-delà, le traitement n'eut pas de succès. Deux d'entr'eux durent être réopérés et le 3^e, un homme âgé, atteint de cholangite grave, mourut de bronchopneumonie. On peut mettre en doute que le traitement par l'éther ait joué un rôle quelconque dans ce décès, qui est cependant un avertissement à user de retence en cas de cholangite. Par ailleurs on n'a pas vu de suites malheureuses imputables à ce traitement. La méthode de Pribram peut donc être recommandée lorsqu'il s'agit de calculs petits, et doit sans doute être essayée aussi lorsqu'ils sont plus gros, à condition qu'ils soient solubles dans l'éther, ce dont il faut s'assurer au préalable par un essai in vitro sur des calculs provenant du même malade — L'auteur recommande de combiner la cholangiographie primitive avec la cholangiographie secondaire, non seulement dans les cas de cholélithiasis, mais aussi là où l'on a pratiqué une cholédoctomie parce qu'on suspectait la présence de calculs dans les voies biliaires profondes.

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Pseudo-Agglutination,

a Previously not Described Stable Form Causing Errors in Clinical Blood Grouping and Compatibility Tests.

By

OTTO HARTMANN and REIER SCHØNE.

If test sera with high titres are used in blood grouping, it is practically impossible to overlook positive reactions; the only exceptions are the rare, weakest subtypes of A which have recently been demonstrated by A. GAMMELGAARD (1). However, there are several phenomena which may cause the reverse, that is that negative reactions may be considered positive. Of these the most important are:

1) *cold agglutination*, which now and then gives marked reactions at room temperature. As good test sera contain little or no cold agglutinins, this source of error will be of significance only in compatibility tests.

2) *Thomsen's phenomenon (panagglutination)* which is caused by the enzymes of certain bacteria, does not manifest itself when fresh blood corpuscles are used and can thus be avoided as a source of error when fresh blood is examined.

Both cold agglutination and THOMSEN's phenomenon are true agglutinations, which are due to the reaction between an agglutino-gen and an agglutinin, which latter can always be removed from the serum by absorption with the corresponding agglutino-gen.

3) *Pseudo-agglutination in the form of rouleaux* occurs in serum from patients whose blood corpuscles have a high sedimentation rate, presenting the characteristic picture where the erythrocytes accumulate with the concave surfaces toward each other as larger or smaller rouleaux. When the rouleaux formation is very pronounced, their form is more irregular and they are clumped to-

gether, and have the appearance of true agglutination. But in contrast to the situation in a true agglutination, this property cannot be removed from the serum by absorbtion.

The rouleaux formation is further characterized by the fact that practically all of the blood corpuscles enter into the rouleaux formation when the preparation has stood for a while. This is not the case with weak agglutinations, as here there are always a considerable number of free, individual blood corpuscles. The rouleaux formation is more pronounced at higher temperatures while agglutinations are stronger at lower temperatures. The rouleaux formation can be eliminated by a weak dilution of the serum (1 to 2 or 1 to 3). One of the most characteristic features of the rouleaux formation is the readiness with which it is eliminated by slight circulation of the fluid. Even a slight movement of the preparation completely eliminates the rouleaux formation but the rouleaux form anew when the preparation is left lying still again. Rouleaux formation is nonspecific, so that a serum which causes rouleaux formation will do the same with all erythrocytes regardless of blood group, also with its own blood corpuscles, but there may be a marked difference of degree.

Phenomena similar to rouleaux formation may be produced with a normal serum if substances which increase its viscosity are added, such as gum acacia or gelatin, or by growth of slime-producing microbes in the serum.

In some cases rouleaux formation may take place only with foreign blood corpuscles and not with the patient's own, as in a case which K. LANDSTEINER has observed and reported personally to A. S. WIENER (2). In this case the patient's serum was apparently incompatible with the blood corpuscles of donors of the same group. The undiluted serum of this patient gave pronounced clumping and rouleaux formation with concentrated blood corpuscle suspensions from these donors both on slides and in test tubes, while there was little or no clumping when the serum was tested with own blood corpuscles. The phenomenon was eliminated by shaking or weak dilution of the serum, and was not caused by an absorbable agglutinin. A transfusion of 300 cc blood was given without reaction.

A peculiar form of pseudo-agglutination was observed by S. H. POLAYES, M. LEDERER and A. S. WIENER (3) in serum from umbilical cords. The agglutination was nonspecific, as all erythrocytes, regardless of type, were influenced, and it occurred only

when the preparation was in motion, exactly the opposite of the case in rouleaux formation. The property could not be absorbed out of the serum. Closer investigation revealed that the pseudo-agglutination was caused by an admixture of embryonic connective tissue from the umbilical cord (WHARTON'S jelly).

In recent years it has often happened that we have received blood samples from patients and donors where the compatibility tests have not been in order. In some of these cases we have not been able to find any incompatibility, in other cases there have been erroneous blood groupings, in still others we have found irregular agglutinins or pseudo-agglutination as a result of rouleaux formation; but in some of these cases we have observed forms of pseudo-agglutination which we have not previously seen described. In all we have found 6 cases, 2 from Oslo hospitals and 4 from various out of town hospitals. We shall first give a short account of the most important data and the main findings in our investigations of these cases:

Case 1. Woman, aged 64. Admitted for icterus and hepatitis. $16/9$, 1943 choledochus drainage. $18/9$, 1943 the alkali reserve was 20 volume % and NaHCO_3 was administered intravenously. Mors uremic $20/9$, 1943. Post mortem examination revealed acute yellow liver atrophy. Hemoglobin percent was 100 in May, 78 in June, 97 in Sept. Blood sedimentation was $25/5$, 114 mm., $10/6$, 103 mm., $15/9$, 67 mm and $18/9$, 44 mm. During hospitalization in Sept. she was afebrile with the exception of a rise in temperature one day to 37.7°C . Because of incompatibility no blood transfusion was given.

Our investigation: The blood group was $A_1 M$ with an anti-B titre of 128. The serum agglutinated a number of blood corpuscles of types O, A_1 , and A_2 . At any rate the macroscopic picture resembled true agglutination, as the phenomenon was very stable against shaking of the slide. The same phenomenon occurred with own blood corpuscles. Microscopically there were some rouleaux formations, but also apparently true agglutinates. The serum was absorbed with an excess of thrice washed O M blood corpuscles. The absorbed serum still agglutinated O M blood corpuscles from the same individual just as strongly. The agglutination also occurred at 37°C .

Case 2. Woman, aged 28. Admitted $21/9$, 1943 for hematemesis. She was grouped as O and was given a transfusion of 500 cc. citrate blood of type O. Some hours later she became comatose but had no hemolytic reaction, urine benzidin —. The following day her urine was still benzidin —. Alkali reserve 38 vol. %. A blood culture gave abundant growth of hemolytic streptococci. Mors the same afternoon with no return to consciousness. The O blood donor used had an anti-A titre of 256 and an anti-B titre of 256. Blood sedimentation $18/12$ 1942 was

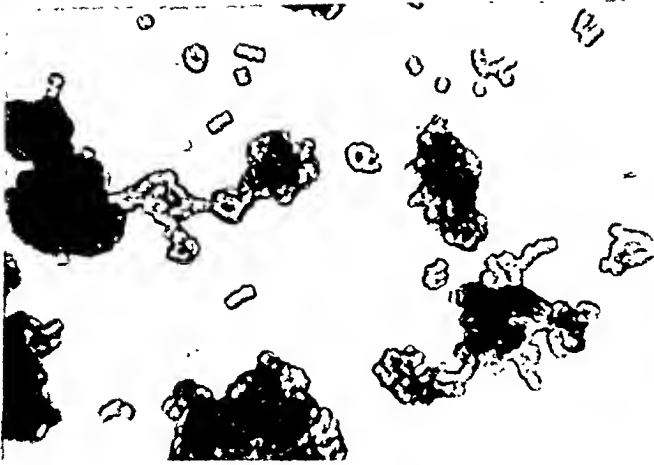


Fig. 1. Pseudo-agglutination and rouleaux formation. Case 2. \times ca. 150.

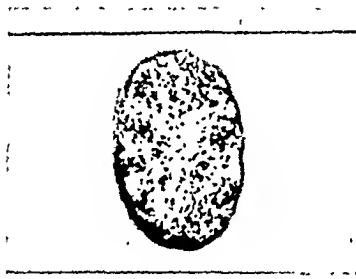


Fig. 2. Pseudo-agglutination on a slide. Case 5. Natural size.

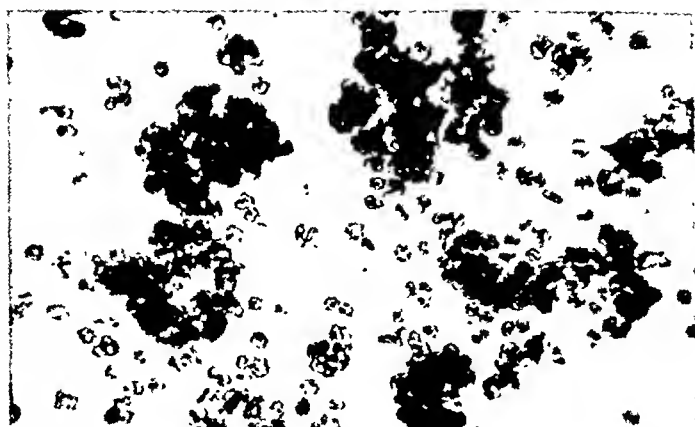


Fig. 3. Pseudo-agglutination without rouleaux formation. Case 6. \times ca. 150.



Fig. 4. Pseudo-agglutination, indication of rouleaux formation. Case 6. \times ca. 800.

137 mm., $^{5/1}$ 1943 129 mm. $^{24/9}$ 1943 128 mm. Temperature $^{24/9}$ was 38.6° C. No rise in temperature after the transfusion until the evening of the next day to 40° C. No new transfusion was administered because of incompatibility.

Our investigation: Blood group B MN with anti-A titre of 256. The serum gave pronounced macroscopic agglutination of a number of different B and O blood corpuscles, own blood corpuscles were also agglutinated. Microscopically the phenomenon was seen to consist of some medium strong rouleaux, some apparently true agglutinates. The rouleaux formations were, in contrast to what they usually are, very stable against shaking of the slide. The serum was absorbed at 7° C with an excess of thrice washed blood corpuscles of the O MN type. The absorbed serum still agglutinated blood corpuscles of the type O MN from the same individual, also at 37° C (Fig. 1).

Case 3. Woman, aged 36. Admitted $^{10/3}$ 1942 for prolonged pregnancy. $^{19/3}$ partus. Bleeding 700 g. Blood transfusion was desirable for this patient who was determined as type B, but the compatibility test showed that the patients serum agglutinated B blood corpuscles from several different donors, and also O and AB blood corpuscles, so no transfusion was made. The patient was afebrile with the exception of a rise in temperature to 38° C on $^{18/3}$. No blood sedimentation test was made.

Our investigation: The blood group was B MN with an anti-A titre of 128. The coagule had the characteristic appearance of a highly increased blood sedimentation rate. In testing the serum against 5 different samples of B blood corpuscles and 5 different samples of O blood corpuscles, all showed agglutination. The agglutination was somewhat weaker when the slide was shaken, but was still very pronounced. It was just as strong at 37° as at 7° C. After absorption of the serum with equal parts thoroughly washed, concentrated B blood corpuscles the agglutination still occurred with B corpuscles from the same individual as used for the absorption. There was also auto-agglutination, similarly independent of temperature.

Case 4. Man, age not recorded, suffering from cavernous pulmonary tuberculosis. He was grouped as AB. On compatibility tests with 4 AB, several O and a couple of A donors there was agglutination. An A donor was finally found who showed good compatibility and on $^{21/1}$ 1942 400 cc. citrate blood from this donor was administered to the patient. After 20 cc. the patient had profuse perspiration but no other symptoms and after the transfusion there was no other reaction than temporary chills. On $^{12/1}$ 1942 the hemoglobin % was 59 and blood sedimentation 125 mm., on $^{26/2}$ 1942 the hemoglobin % was 46 and sedimentation rate 114 mm. The sedimentation rate remained around and over 100 mm. for a long time both before and after the transfusion. Temperature was subfebrile before the transfusion. There was no change after the transfusion except for the above mentioned chills. The urine contained some red blood corpuscles both before and after the transfusion but there were no indications of hemolysis as a result

of the transfusion. No further transfusions were carried out because of incompatibility.

Our investigation: The blood group of this patient was A₁B N. The serum gave a weak agglutination of all of the test blood corpuscles employed independent of type. After absorption of the serum with an excess of the agglutinable erythrocytes the property of the serum was unaltered. Microscopically there was pronounced rouleaux formation. In contrast to ordinary rouleaux formation it is stable, as it is not eliminated by shaking of the slide. The phenomenon also occurs with own blood corpuscles but to a less pronounced degree. It occurs at refrigerator temperature as well as at 20° C, 37° C and weaker at 55° C.

Case 5. Man, aged 49. Admitted 16/3 1943 with the diagnosis pleurisy. An empyema developed and he was operated several times with opening and drainage of the empyema cavity. During the latter part of his stay at the hospital his temperature was subfebrile. Blood sedimentation was 84 mm. — 103 mm. — 119 mm. He was group determined as A. In June and July he was given 3 blood transfusions from A donors. The preliminary tests were in order and there was no reaction after the transfusions. On 7/9 1943 the patient's serum agglutinated the blood corpuscles of 3 different A donors at room temperature. However there was no agglutination with blood corpuscles from a donor of type O, and blood was administered from this donor with no subsequent reaction. On 17/9 1943 the serum of this patient agglutinated blood corpuscles from a new donor of type A as well as from 2 donors of type O. No further transfusions were carried out.

Our investigation: The blood type was A₂ MN with an anti-B titre of 64. The serum agglutinated just as strongly blood corpuscles from three different samples of A₁ and two of A₂, as well as 4 O, while the corpuscles from one O sample were not agglutinated. The serum was absorbed with 5 parts thrice washed O blood corpuscles and still agglutinated blood corpuscles from the sample just as strongly afterwards (Fig. 2). The serum absorbed with an excess of B blood corpuscles still agglutinated B and AB blood corpuscles in the same manner. All hemolysis tests were negative. On titration of the agglutination the serum in this case showed a very high titre, namely 128 at 7° C, 256 at 20° C and 1024 at 37° C. The agglutination on the slide was only partly destroyed by violent shaking. No definite rouleaux formations could be seen microscopically, it looked like a true agglutination.

Case 6. Man, aged 20. Lymphogranulomatosis. The patient was given 4 transfusions from O donors on 28/8, 31/8, 2/9 and 4/9 1943. Before administration of the 5th transfusion agglutination was discovered in the preliminary test. The patient was type determined anew and his blood corpuscles were then agglutinated by both test serum A and test serum B, so it was decided that he did not belong to blood group O but to AB. However it was found that the patient's serum agglutinated blood corpuscles from an AB donor. Blood sedimentation on 31/8 was 115 mm., 10/9 142 mm., 14/9 125 mm., 28/8 160 mm., 6/9 165 mm., and 18/9 128 mm. His temperature stayed around 38° C.

On $8/_{10}$ 1943 the hemoglobin % was 53, index 1, white blood corpuscles 5 200.

Our investigation: The blood type was O MN with an anti-A titre of 256 and an anti-B titre of 256. The blood corpuscles were agglutinated by 3 O, 5 A and one AB serum, and somewhat more strongly by 2 B sera. They were also agglutinated, but more weakly, in their own serum. The agglutinations persisted in spite of violent shaking of the slides, and microscopically they resembled true agglutination, no rouleaux formation (Figs. 3 and 4). The patient's blood corpuscles were agglutinated by A and B sera just as strongly at 7° C, 20° C and 37° C and there was a very weak agglutination at 56° C. One B serum which was absorbed with an excess of the patient's blood corpuscles agglutinated these corpuscles just as strongly after absorption. While specifically agglutinated blood corpuscles became hemolysed on the addition of complement (guinea pig serum) and incubation at 37° C in a water bath, there was no hemolysis in this case.

On the basis of our investigations the patient was given 4 additional blood transfusions from O donors on $9/_{9}$, $15/_{9}$, $18/_{9}$ and $23/_{9}$ 1943, all without complications. There was never hemoglobinuria. On subsequent testing of the patient's blood corpuscles on $19/_{9}$ 1943 the same phenomenon was observed, as they were strongly agglutinated in one AB and 3 B sera, somewhat less strongly in 4 O and one A serum, weakly in one B serum and not in 2 A sera.

In the first 5 of our cases the exceptional properties are connected with the patient's serum. All of these cases are distinctly different from ordinary rouleaux formation and also from the case observed by K. LANDSTEINER, as the phenomenon is very stable against shaking of the preparation, both in test tubes and on slides. Pseudo-agglutination was just as stable or in some cases at least almost as stable as a corresponding true agglutination, as the latter also may be weakened or partly eliminated sometimes by violent shaking, so that in this respect there is no difference between the observed pseudo-agglutination and a true agglutination.

Microscopically there was pronounced rouleaux formation in some of the cases (Fig. 1). But in addition to the rouleaux formations there were much larger, more irregular clumps of blood corpuscles. As there is no reason why rouleaux formation and true agglutination should not occur simultaneously, this cannot be employed to distinguish the observed phenomenon from a true agglutination. Moreover in some cases the rouleaux formation was very slight or entirely lacking.

The ordinary rouleaux formations can be eliminated by slight dilution of the serum, as 1: 2 or 1: 3, also in the case observed

by K. LANDSTEINER. In the type of compatibility tests usually employed at our hospitals, the serum is mixed with equal parts of a thin suspension of blood corpuscles, so that the serum dilution is 1:2 where there is little chance for the manifestations of rouleaux formations. And the phenomenon was not eliminated in any of our 5 cases by slight dilution of the serum. On the contrary in one of the cases (Case 5) there was an unusually high titre. This demonstrates that the phenomenon cannot be explained in the same manner as rouleaux formation by assuming that an increased viscosity of the serum is responsible.

In the observed cases there was no difference in the degree of the pseudo-agglutination at varying temperatures, or the phenomenon was more pronounced at higher temperatures (37° C). In this respect pseudo-agglutination resembles rouleaux formation but is distinguished from true isoagglutination and especially from cold agglutination, which is considerably stronger at low temperatures and is never seen at 37° C.

On the addition of guinea pig complement to the pseudo-agglutinated blood corpuscles it was never possible to produce hemolysis at 37° C (not even in Case 5), while hemolysis occurs regularly under the same conditions with specifically agglutinated blood corpuscles when the titre is sufficiently high.

Only the absorption experiments are decisive for distinguishing them from a true agglutination. In all of the observed cases even an absorption with a large excess of blood corpuscles, sometimes with repeated absorption tests one after the other, produced no alteration in the observed phenomenon (Figs. 1 and 2). This proves that the phenomenon is a pseudo-agglutination.

The pseudo-agglutination was nonspecific in all cases, so that it occurred with various blood corpuscles, regardless of type. But there was usually a quantitative difference. In case 5 this difference was so pronounced that we thought we were dealing with an irregular agglutinin, before the absorption tests showed that this was not the case.

In Case 6 it was not the patient's serum, but his blood corpuscles which showed pseudo-agglutination in various sera (Figs. 3 and 4). In this case it was not possible to find any characteristic rouleaux formations in any of the preparations (there is a slight indication of such in Fig. 4), but the pseudo-agglutination microscopically resembled a true agglutination as there were considerable numbers of free, individual blood corpuscles between the

clumps of corpuscles. In this case the phenomenon caused the hospital to classify the patient as AB instead of O when the new type determination was made before the 5th transfusion. Here also the pseudo-agglutination was largely independent of temperature and the property could not be absorbed out of a serum by absorption with an excess of the patient's blood corpuscles. Hemolysis tests were negative.

If an attempt is made to discover under what conditions the phenomenon occurs, it is seen that the only distinct common feature for all the cases described here is the very high sedimentation rate of the red blood corpuscles. Even though this pseudo-agglutination presents characteristics which distinctly distinguish it from ordinary rouleaux formation, we are nevertheless of the opinion that the two phenomena are very closely related. We also believe that pseudo-agglutination, like rouleaux formation, is a purely physical phenomenon which can only be produced *in vitro* and never occurs *in vivo*. This latter is also indicated by the fact that pseudo-agglutination may occur with own blood corpuscles. It is highly probable that Case 6 is also of a similar nature as the other cases, even though this case presents the peculiar situation that the phenomenon is connected with the blood corpuscles.

Pseudo-agglutination seems to occur regardless of whether the patient has previously had blood transfusions, as previous blood transfusions had only been carried out in Cases 5 and 6.

The form of pseudo-agglutination which we have described here may readily give rise to erroneous interpretation of compatibility tests, as was done in these cases. In forms like Case 6 the pseudo-agglutination may also lead to erroneous type determination, when this is carried out in the manner usually employed in clinical laboratories without examination of the agglutinins. This form may also appear if the compatibility test is carried out against the patient's blood corpuscles before serum or plasma transfusions.

As the prerequisite for the appearance of this pseudo-agglutination seems to be a very high sedimentation rate of the red blood corpuscles, it will be of no significance in examinations of healthy persons.

We are of the opinion that pseudo-agglutination is of no significance in blood transfusions, and will cause no complications for the recipient. In our Case 6 the patient was given 4 blood

transfusions after the demonstration of the pseudo-agglutination without manifesting the least reaction in spite of the fact that the phenomenon was also present on renewed investigation after these transfusions had been carried out.

Pseudo-agglutination of this type cannot be a rare phenomenon, even though it has not been previously described. In addition to the cases which have been sent to us for closer investigation there must certainly have been many others at our hospitals which have not been recognized. In such cases the patient may have to get along without a blood transfusion which in other respects is definitely indicated. It is therefore important that clinical laboratories should be aware of the possibility of pseudo-agglutination of this type when the compatibility tests are not in order and should be able to distinguish it from a true agglutination.

Summary.

Five cases are recorded in which the serum of the patients agglutinated all red blood corpuscles irrespective of blood groups; however certain quantitative differences were seen. There was also agglutination of own corpuscles to a somewhat lesser degree. In another case, the corpuscles from a patient (group O) were agglutinated in sera from all blood groups, thus simulating the group AB in the clinical blood grouping tests. All of the patients concerned exhibited a very high sedimentation rate of the red corpuscles. The pseudo-agglutination was not connected with any particular disease, nor with previous transfusions.

The phenomenon resembles the rouleaux formation, as the property cannot be removed by absorption. It is also independent of temperature differences. It differs however distinctly from the ordinary rouleaux formation in its great stability, it is not inhibited by shaking nor by slight dilutions of the serum. In one of the cases (Case 5) the phenomenon was present even in very high dilutions. Microscopically there is always a great resemblance to genuine agglutination, but in some cases stable rouleaux formations are also seen. The phenomenon does not interfere with blood transfusions. In one of the cases the patient was given 4 transfusions after the demonstration of the pseudo-agglutination without the slightest untoward reaction.

Zusammenfassung.

Pseudo-Agglutination, eine vorher nicht beschriebene stabile Form, wodurch Fehler hervorgerufen werden bei der klinischen Blutgruppen-Bestimmung und bei Verträglichkeits-Untersuchungen: Fünf Fälle sind verzeichnet, wo das Serum der Patienten alle roten Blutkörperchen ungeachtet der Blutgruppen zusammengeballt hat; gewisse quantitative Unterschiede wurden jedoch beobachtet. Es gab auch Auto-Agglutination in etwas geringerem Masse. In einem anderen Falle wurden die Blutkörperchen des Patienten (Gruppe O) in Seren aus allen Blutgruppen zusammengeballt, so dass sie sich wie die Gruppe AB in den klinischen Blutgruppen-Bestimmungen verhielten. Alle die betreffenden Patienten wiesen eine sehr hohe Sedimentierungs-Geschwindigkeit der roten Blutkörperchen auf. Die Pseudo-Agglutination war mit keiner besonderen Krankheit verbunden, noch mit wiederholten Übertragungen.

Das Phänomen gleicht der Geldrollen-Bildung, da die Eigenschaft nicht durch Absorption beseitigt werden kann. Es ist auch von Temperaturschwankungen unabhängig. Es unterscheidet sich indessen erheblich von der gewöhnlichen Geldrollen-Bildung durch seine grosse Stabilität, indem es weder durch Schütteln noch durch schwache Verdünnung des Serums beeinträchtigt wird. In einem der Fälle (Fall 5) war das Phänomen auch in sehr ausgesprochenen Verdünnungen vorhanden. Bei mikroskopischer Untersuchung wird immer eine grosse Ähnlichkeit mit echter Agglutination beobachtet werden, aber in einigen Fällen kann man auch stabile Geldrollen-Bildungen feststellen. Das Phänomen wirkt nicht auf Blutübertragungen störend ein. In einem der Fälle erhielt der Patient nach Feststellung der Pseudo-Agglutination vier Übertragungen, ohne die geringste unerwünschte Reaktion.

Résumé.

Pseudo-agglutination, une forme stable qui n'a pas été décrite auparavant et qui provoque des erreurs dans la détermination des groupes sanguins et dans les épreuves de compatibilité cliniques: Cinq cas ont été rapportés dans lesquels le sérum des sujets malades a agglutiné tous les globules rouges de n'importe quel groupe sanguin; on a toutefois pu constater quelques différences

quantitatives. Il y avait aussi auto-agglutination dans une mesure un peu inférieure. Dans un autre cas les globules du sujet (groupe O) furent agglutinés dans des sérums tirés de tous les groupes sanguins, agissant ainsi comme le groupe AB dans les épreuves cliniques pour la détermination des groupes sanguins. Tous les sujets en question ont accusé une vitesse très élevée de sédimentation des globules rouges. La pseudo-agglutination n'était combinée avec aucune maladie particulière ni avec des transfusions répétées.

Le phénomène ressemble à la formation de rouleaux, étant donné que la propriété ne peut pas être éliminée par absorption. Il est aussi indépendant des différences de température. Toutefois, il est par sa grande stabilité distinctement différent de la formation ordinaire de rouleaux, puisqu'il n'est inhibé ni par remuage ni par des dilutions faibles du sérum. Dans l'un des cas (cas 5) le phénomène se présenta même dans des dilutions très prononcées. Microscopiquement il y a toujours une grande ressemblance à l'agglutination véritable, mais dans quelques cas des formations stables de rouleaux se voient aussi. Le phénomène ne compromet pas les transfusions sanguines. Dans l'un des cas le sujet reçut quatre transfusions après la démonstration de la pseudo-agglutination, sans la moindre réaction fâcheuse.

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Operative Versorgung der Hirnschüsse.

Von

Professor Dr. W. TÖNNIS.

Oberstabsarzt.

Als wir in diesem Krieg zogen, da verfügten wir Jüngeren die wir den ersten Weltkrieg nicht als Chirurgen mitgemacht hatten, über keine persönlichen Erfahrungen auf dem Gebiet der Schussverletzungen des Gehirns. Wir waren angewiesen auf das Schrifttum. Trotz des zahlenmässig grossen Materials war damals keinerlei Einigung in den Behandlungsmethoden erzielt worden. Der primäre Wundschluss (HOTZ, FREY, KÄRGER, BARANY, JEGGER) hatte sich nicht durchgesetzt. Auch war die Darstellung der infektiösen Komplikationen bei den einzelnen Autoren so verschieden, dass hier gegenseitige Missverständnisse vorliegen mussten, deren Ursache noch zu klären war.

Der an der Front eingesetzte Chirurg hat nur selten Gelegenheit etwas über das endgültige Schicksal der von ihm versorgten Verwundeten zu erfahren. Die Verwundeten werden von Lazarett zu Lazarett weitergegeben und die sie jeweils behandelnden Chirurgen sehen nur die eine, ihnen gegenwärtige Phase im Ablauf der Wundheilung. Viele auseinandergehende Meinungen im Schrifttum erklären sich auf diese Weise.

Ganz besonders werden aber von dieser Tatsache die Verletzungen betroffen, die, wie z. B. die Hirnschussverletzungen, erfahrungsgemäss oft trotz anfänglich scheinbar störungslosem Verlauf noch lebensbedrohende Spätkomplikationen haben können. Der erstversorgende Chirurg, dem diese Komplikationen nur durch das Schrifttum bekannt werden, hat deshalb leicht ein zugünstiges Urteil über seine Erfolge, da er die später noch auftretenden Komplikationen nicht selbst zu sehen bekommt.

So konnte es trotz der ungeheuren Arbeit, die die Weltkriegsärzte von 1914/18 geleistet haben, nicht zu einer Beschreibung des Verlaufes der Hirnschussverletzungen von der Erstversorgung bis zur Entlassung aus dem Heimatlazarett kommen, da kein Arzt die Verwundeten solange in eigener Beobachtung halten konnte.

Erstmalig in diesem Kriege war es durch die Organisation die vom Inspekteur des Sanitätswesens der deutschen Luftwaffe für die Behandlung der Hirn-, Rückenmark- und Nervenverletzten geschaffen wurde, möglich, diese Lücke auszufüllen. Hirnchirurgische Bereitschaften an der Front geben ihre versorgten Hirn- und Rückenmarksverletzten an zentrale Sammellazarette der Heimat ab. Hier stehen eine neurochirurgische Abteilung für die Behandlung der infektiösen Spätkomplikationen, Epilepsien usw. und drei neurologische Abteilungen zur Verfügung, von denen eine die peripheren Nervenverletzungen, die andere die aus der Wehrmacht zu entlassenden und die dritte die zur Wehrmacht zurückkehrenden Hirn- und Rückenmarksverwundeten betreut.

Den Abteilungen sind angegliedert eine Sprachschule mit Lehrern für Aphasie, Denk- und Schreibstörungen, eine Sehschwachenschule, dann Werkstätten für Holz, Leder, Bast und Tonarbeiten, die zur Behandlung feinerer Bewegungsstörungen dienen. Heilgymnastische Einzelbehandlung zuerst, später Gruppensport und Schwimmen dienen der Übungsbehandlung von Bewegungsstörungen. Daneben gibt uns das sportliche Training aber auch die Möglichkeit über die Wirkung auf das vegetative Nervensystem, vor allem auf die Gefässnerven eine Wiederlangung der verlorengegangenen Elastizität des ganzen Organismus anzustreben. Indirekt beeinflussen wir über das vegetative System auch wieder die Rückbildung der Einzelausfälle und es unterliegt für uns gar keinem Zweifel, dass unter der Allgemeinbehandlung Sprachstörungen und Lähmungen — wofern sie überhaupt rückbildungsfähig sind — schneller zurückgehen, als wir das vom Weltkrieg beschrieben finden und von unseren Friedensverletzungen her kennen.

In diesem Behandlungsgang nimmt die operative Erstversorgung an der Front einen entscheidenden Platz ein. Sie schafft erst die Voraussetzungen, ohne die eine so intensive sportliche Belastung nicht durchführbar wäre. Andererseits erfährt die Art des operativen Vorgehens an der Front eine fortlaufende Kritik durch die Beobachtungen im Heimatlazarett. Da die gesamte ärztliche

Leitung und Verantwortung bei den an der Front eingesetzten hirnchirurgischen Bereitschaften und im Heimatlazarett in den Händen des Beratenden Neurochirurgen des Inspektors liegt, können Fehler im operativen Vorgehen im Einzelnen rasch abgestellt und Erfahrungen mit Hilfe der ihm unterstehenden Forschungsstelle für Hirn- Rückenmarks- und Nervenverletzungen bald ausgewertet werden. Besonders wertvoll hat sich die Zusammenarbeit mit den Neurologen u. Hirnpathologen unter der Führung von Prof. SPATZ erwiesen. Jede Bereitschaft an der Front hat einen Pathologen, der das anfallende Sektionsgut für die endgültige Bearbeitung in der Heimat sammelt.

So schien es mir zunächst die wichtigste Aufgabe zu sein, den Verlauf der unversorgten Hirnschüsse genauer zu beobachten, um einen Einblick in das Auftreten der verschiedenen Komplikationen zu gewinnen. Hieraus ergab sich die Aufstellung eines neuen klinischen Einteilungsschemas, das alle gleichartigen Verletzungsformen zusammenfasste, die dann wieder nach ihren typischen Komplikationen unterteilt werden:

A. Schussverletzungen des Schädeldaches:

I. I m p r e s s i o n s s c h ü s s e

1. ohne Duraeröffnung

- a) ohne neurologischen Ausfälle
- b) mit neurologischen Ausfällen

2. mit Duraeröffnung

- a) ohne Prolaps (verlegte Knochenlücke) Typ I
unkompliziert

kompliziert

mit intracerebraler Blutung

mit ausgedehnter Quetschung des Gehirns

mit Ventrikeleröffnung

mit grösseren Stecksplitter

- b) mit Prolaps (offene Knochenlücke) Typ II

II. S t e c k s c h ü s s e

- 1. gleichseitig zur Einschussöffnung
- 2. gegenseitig zur Einschussöffnung
- 3. mit Hirnstammverletzung.

III. D u r c h s c h ü s s e.

B. Schussverletzungen des Schädelgrundes:

I. Impressionschüsse

1. ohne Duraverletzung
2. mit Duraverletzung
 - a) ohne Hirnwunde
 - b) mit Hirnwunde
 - unkomplizierte
 - komplizierte
 - mit ausgedehnter Quetschung des Gehirns
 - mit Ventrikeleröffnung
 - mit grösseren Stecksplitter

II. Steckschüsse

1. gleichseitig zur Einschussöffnung
2. gegenseitig zur Einschussöffnung
3. mit Hirnstammverletzung.

III. Durchschüsse

Dieses Schema hat sich in der nunmehr vierjährigen Arbeit bewährt. Vor allem gestattet es, für alle neuauftauchenden Probleme eine rasche Klärung zu gewinnen, da es die statistische Erfassung des Behandlungsergebnisses für die unter sich gleichartigen Fälle in einer überzeugenden Form vermittelt. Da alle Todesfälle seziert und durch Prof. SPATZ und seine Mitarbeiter in der notwendigen Weise bearbeitet werden konnten, war es möglich, die Behandlungsmethoden unter dem Gesichtspunkt des Misserfolges zu werten und die Frage nach der Richtigkeit des chirurgischen Vorgehens im Einzelnen von dieser Seite her aufzurollen.

So wurde zunächst die Wirksamkeit der *Infektionsprophylaxe* in der Hirnwunde einer kritischen Prüfung unterzogen. Dann wurden auf Grund des Misserfolges, die *Verhütung des subduralen Empyems*, das im Weltkriegsschrifttum keine wesentliche Berücksichtigung fand, und der *direkten Meningitis*, deren Bedeutung zu Unrecht hinter die indirekte gestellt wurde, zu einer neuen Methodik ausgearbeitet. Als eines der schwerwiegendsten Probleme aber stellt sich dann die *Behandlung der primären Eröffnung der Ventrikel und der grossen Zisternen* heraus. Auch die *Versorgung der Steckschüsse* erforderte eine neue Bearbeitung.

Unter der *Versorgung einer Wunde* verstehen wir die Beseitigung der unmittelbar bedrohlichen Verletzungsfolgen und die Ver-

hütung der noch zu erwartenden. Im Falle der Hirnschüsse würde das bedeuten, die *Behandlung der intracraniellen Blutungen* und die *Vorbeugung der Infektion*. Die Vorbeugung der Infektion könnte rein überlegungsmässig erfolgen bis zum Ausbruch derselben, d. h. bis etwa zum 6. Tage nach der Verwundung. Bei Impressionschüssen mit Ventrikeleröffnung tritt die Meningitis gewöhnlich schon am 5. Tage auf. Impressionschüsse mit verlegter Knochenlücke lassen am 5. oder 6. Tage bisweilen im Zentrum der Splitterpyramide bereits eine Eiteransammlung erkennen, während das ausfliessende Wundsekret noch trüb serös ist. So kann man wohl das Ende der ersten Woche als den Zeitpunkt der beginnenden Wundeiterung ansprechen. Die direkte Meningitis gibt sich ebenso wie das subdurale Empyem gewöhnlich erst in der zweiten Woche zu erkennen. Der Frühabszess wird als solcher bei unversorgten Fällen erst gegen Ende der zweiten Woche am eitrigen Ausfluss aus der Wunde bemerkbar.

Erkennen wir der Frühversorgung die ersten 24 Stunden nach der Verwundung zu, so fragt es sich, wie die Hirnschüsse von 2. bis 6. Tage nach der Verwundung zu behandeln sind.

Wir haben bereits 1940 den primären Wundschluss bis zum 5. Tage nach der Verwundung ausgeführt. Auch GULEKE und SORGO haben über gute Erfolge in dieser Hinsicht berichtet. Es wird meine Aufgabe sein, dieses Vorgehen im Einzelnen zu begründen.

Infektionsverhütung in der Hirnwunde:

Während im ersten Weltkrieg der primäre Wundschluss entweder zur Verhütung des Prolapses (FREY, HOTZ, KAERGER) oder der Sekundärinfektion (BARANY, JEGGER) angewandt wurde, sehen wir heute als das Wesentliche der Versorgung die *Infektionsprophylaxe in der Hirnwunde an*, die wir durch eine radikale Ausräumung anstreben.

Das G r u n d p r i n z i p ist folgendes: da eine quantitative Entfernung aller in die Wunde eingeschleppten Bakterien nicht erwartet werden kann, hat die operative Versorgung das Ziel zu verfolgen, die Lebensbedingungen der noch verbleibenden Bakterien durch Entfernung aller ihnen willkommenen Nährstoffe (Hirntümmer, Blutkoageln usw.) so ungünstig zu gestalten, dass der Organismus im Abwehrkampf gegen die Bakterien Sieger bleibt. Dies erreichen wir durch eine radikale Ausräumung der Hirnwunde mit dem Sanger, wobei alles tote Gewebe und alle einge-

drungenen Fremdkörper restlos entfernt werden. Die Duralücke muss zur Vermeidung einer Sekundärinfektion der Hirnwunde und zur Verhütung eines Hirnprolapses durch wasserdichtes Einnähen eines gestielten Galeaperiostlappens geschlossen werden. Die einfache *Duranaht* bietet in vielen Fällen nicht die genügende Sicherheit. Deshalb decken wir sie grundsätzlich mit einem Galeaperiostlappen. Die Weichteilwunde wird — wenn die Versorgung innerhalb der ersten 48 Stunden erfolgt, — zweischichtig darüber vernäht. Nach dem 2. Tag vereinigen wir die Weichteile über einem weichen Gummidrain durch eine Naht der Galea mit dickem Catgut, das bei Auftreten einer Eiterung in der Weichteilwunde von selbst aufgeht.

Dieser *wasserdichte Duraschluss* ist nun von der entscheidendsten Bedeutung bei den basalen Schussverletzungen, wenn gleichzeitig Nebenhöhlen und Dura eröffnet werden. Hier hängt erfahrungsgemäss alles von einer möglichst frühzeitigen und sehr radikalen Ausräumung der verletzten Nebenhöhlen, Freilegung der Duralücke, Ausräumung der Hirnwunde, zuverlässigen Duraschluss und Ableitung der Nebenhöhlen in die Nase und nach aussen ab.

Die Infektionsverhütung in den subarachnoidalen Räumen.

Die Infektion der subarachnoidalen Räume geschieht gleichzeitig mit der der Hirnwunde. Der durch die Bewegungen des Gehirns bewirkte Sog bringt die Bakterien in die Liquorräume. Auf diese Möglichkeit machte schon BARANY aufmerksam. Ob die Infektion angeht, hängt ab von den Lebensbedingungen, die die Bakterien hier finden. Subarachnoidale Blutungen begünstigen sie. Deshalb versuchen wir blutigen Liquor durch ausgiebige Punktionen zu entfernen und überwachen dann fortlaufend den Liquor. Gegen den 4. Tag zeigt der Liquor das Bild einer »meningealen Reaktion«. Neben einer erheblichen Eiweissvermehrung tritt eine Vermehrung der Leukocyten auf. Das gleiche Bild wie es ebenso nach subarachnoidalen Blutungen bei stumpfen Traumen oder nach aseptischen Hirnoperationen beobachtet wird. (PAYR, ZANGE, TÖNNIS). Das Allgemeinbefinden der Verwundeten ist ausser den Kopfschmerzen, *verhältnismässig wenig* gestört. Die Temperatur bewegt sich um etwa 39 Grad. Dabei ist der Puls in der Regel relativ verlangsamt. Aber bereits in diesem Stadium haben

wir im Liquor positive Bakterienbefunde erheben können. Aus dieser meningealen Reaktion kann sich die toxische Meningitis entwickeln. Zunächst steigt die Pulsfrequenz, die Verwundeten werden benommen, delirant. Das Gesicht lässt die eigenartige Mischung von Fiebrerröte und Zyanose erkennen. Lässt man die Verwundeten in dieses Stadium kommen, so versagt in den meisten Fällen die Behandlung. Wir haben deshalb bereits bei einer Zellzahl von etwa 300/3 zur Verhütung der Meningitis die übliche Behandlung angewandt. Täglich wurde der ganze erreichbare Liquor in SEE- und Evipannarkose von einer Lumbalpunktion aus ausgeblasen. Durch subcutane Tutofusinfusion wurde die Liquorneubildung gefördert. Der Kreislauf wurde durch Strophanthin und Sympatol, gegebenenfalls durch Periston oder Serumkonserven, gestützt. In jedem Falle wurde eine Sulfonamidtherapie (meist Cibazol, Eleudron oder Tibatin) in hohen Dosen durchgeführt.

Komplikationen: das intrakranielle Haematom.

Unter den Komplikationen der Impressionsschüsse nimmt *die Blutung* eine besondere Stelle ein. Sie wirkt *einmal* lebensgefährdend durch die ihr folgende Hirndrucksteigerung, die bei Blutungen aus grösseren Arterien innerhalb der ersten 24 Stunden aufzutreten pflegt. Bei Blutungen aus kleineren Arterien und Venen erst dann, wenn zu dem Haematom noch das Hirnoedem tritt, also in der zweiten Hälfte der ersten Woche.

Zum *andern* kann sie in der Hirnwunde oder im Subduralraum den Nährboden für Infektionen abgeben.

Die arterielle Blutungen der ersten 24 Stunden kann man nur aus der erweiterten, oft auch schon reaktionslosen gleichseitigen Pupille erkennen. Wir haben es uns zum Grundsatz gemacht, alle eingelieferten Verwundeten sofort auf das Pupillenverhältnis zu untersuchen. Nur so kann man schnell die Blutungen herausfinden. Oft ist auch schon, die gegenseitige Pupille erweitert.

Blutungen aus der Carotis oder ihren Ästen werden eben den Hauptverbandsplatz erreichen. Wir haben sie nur bei Bombenangriffen in unmittelbarer Umgebung des Lazarettes erlebt; 3 intrakranielle Verletzungen der Carotis konnten durch Silberclips verschlossen werden. Das ist nur möglich, wenn man die Blutungsstelle durch den Sauger stellen und dann durch einen Silberclips verschliessen kann. Jeder Versuch, durch Tamponade eine der-

artige Blutung zum Stillstand bringen zu wollen, scheitert daran, dass sich die Blutung in dem Subduralraum ergiesst und so das Gehirn gegen die Knochenlücke vorpresst, wodurch jeder weitere Versuch an die Blutungsquelle heranzukommen unmöglich wird.

Die extraduralen Verletzungen der Carotis erfordern einen doppelten Verschluss, einmal die Unterbindung am Hals und dann den Verschluss intradural neben dem Opticus. Wir haben 5 Fälle derartig mit Erfolg versorgt. Für die Verletzungen der Art. cer. ant. und med. gilt technisch das Gleiche wie bei den intraduralen Carotisverletzungen. Von 6 Blutungen aus der Art. cer. ant. gelang es 4 zur Heilung zu bringen. Von 7 Fällen der Art. cer. med. überlebten nur 3, vier Fällen gingen an Pneumonie zu Grunde. Die meisten Fälle kamen innerhalb einer halben, spätestens einer Stunde zur Operation, sanitätstaktisch gesehen, eine anerkennenswerte Leistung.

Gegenüber diesen aus grösseren intrakraniellen Gefässen stammenden Blutungen spielt die epidurale Blutung aus der Art. meningea med. eine verhältnismässig geringe Rolle. Kleinere Blutungen trifft man fast regelmässig an. Hirndrucksteigernde dagegen seltener.

Bedeutungsvoller ist schon die *Blutung aus den Rindengefässen*, die sich in die Wundhöhle ergiesst. Sie macht aber auch nur dann Hirndrucksteigerungen, wenn sie aus grösseren Gefässen stammt. Die Blutungen aus den kleinen Gefässen tamponieren sich wie die venösen selbst, da der Liquordruck zumeist höher liegt als der Venendruck. Damit kommen sie klinisch als hirndrucksteigernde Ursache erst in Betracht, wenn sich zu ihnen das Hirnoedem gesellt.

Eine besondere Rolle spielen hier die *subduralen Haematome*. Um Missverständnisse zu vermeiden, sei festgestellt, dass wir darunter nur raumbeengende Blutungen verstehen. Sie vermögen zusammen mit dem Hirnoedem ernste Komplikationen gegen Ende der ersten Woche zu sein, andererseits müssen wir sie als Quelle der subduralen Empyeme ansprechen. (SPATZ, NOETZEL). Ihre Erkennung ist nahezu unmöglich. Nur als drucksteigernde Ursache gegen Ende der ersten Woche kann man sie vermuten. Aber dann ist auch meistens die Therapie schon zu spät. Auch hier kann nur die Vorbeugung zum Ziele führen.

Besonders eindrucksvoll war für mich folgendes Erlebnis bei einer hirnhirnrigen Bereitschaft. Bei 5 moribund eingelieferten Impressionschüssen wurde bei der Sektion ein subdurales

Haematom bzw. Empyem festgestellt. Bei 5 weiteren Fällen wurde das subdurale Haematom gegen Ende der ersten Woche klinisch vermutet und entleert. Sie starben trotzdem. Erst als wir dazu übergingen in jedem Falle von intraduraler Verletzung den Subduralraum auf Blutungen zu untersuchen, konnten wir von 5 Fällen, bei denen ein Haematom entleert wurde, 4 retten. Seitdem sind die Todesfälle an subduralem Empyem sehr selten geworden.

Ausgedehntere Quetschung des Gehirns.

Unter den Todesfällen der ersten Woche nehmen neben den durch Hirndrucksteigerung zum Tode führenden Haematome die »an der Schwere der Verletzung« sterbenden Fälle die grösste Zahl ein.

Unter dieser Diagnose finden sich die *Fälle direkter oder indirekter Hirnstammschädigung*. Nicht alle Hirnstammstörungen führen unmittelbar zum Tode, aber wenn wir bei der Sektion eine Verletzung des Hirnstammes finden, so dürfen wir durch diesen Befund die Todesursache wohl als gegeben ansehen. Eine eigenartige Beobachtung möchte ich hier einfügen, für die ich noch keine Erklärung zu geben vermag. Seit REICHARD, GAMPER u. a. sehen wir heute den Hirnstamm als den Angriffspunkt des Traumas für die Entstehung des Commotionssyndroms an. Während wir nun aber die Mehrzahl der schwereren supratentoriellen Schussverletzungen und nahezu alle Halsmarkschüsse von einer sofortigen Bewusstlosigkeit gefolgt sehen, fehlt dieselbe bei den meisten subtentoriellen Schussverletzungen oder sie ist hier nur sehr kurz dauern. Diese Verletzungen sind ja überhaupt sehr symptomarm. Oft hört man nur von einem unsicheren Gang — wie betrunken — und erst die genauere Untersuchung deckt dann Kleinhirnzeichen auf.

Sehen wir von dem durch eine direkte Verletzung des Hirnstammes bedingten Todesfällen ab, so finden wir bei der Sektion der durch die »Schwere der Verletzung« verursachten Todesfällen pathologisch-anatomisch keinen Befund, der als Todesursache angesprochen werden könnte. Das Ausmass der Hirnzertrümmerung allein kann hierfür nicht massgebend sein, denn wir setzen in der Tumorchirurgie oft ebenso grosse Substanzdefekte, die ohne Störungen vertragen werden. Aber in vielen dieser Fälle finden

wir ausser den sogenannten neurotischen Lungenblutungen Veränderungen in der Leber, der Milz und den Nieren, die als Zirkulationsstörungen gedeutet werden müssen. Klinisch sind es die Fälle die mit langanhaltender Bewusstlosigkeit, die im Röntgenbild eine ausgedehnte Schädelzertrümmerung oder einen Strahlenkranz von Frakturlinien von einer kleinen Knochenlücke ausgehend erkennen lassen. Es sind dass die hoffnungslosen Fälle, die den Frontchirurgen und seine Helfer seelisch so ausserordentlich belasten, da man ihnen gegenüber so völlig hilflos dasteht. Während die einen völlig schlaff, in wenigen Tagen buchstäblich auslöschen, ausserordentlich stark abmagern und schliesslich an einem Versagen der immer flacher und seltener werdenden Atmung dahingehen, zeigen andere eine psycho-motorische Unruhe seltenstens Ausmasses. Um sie im Bett zu halten, müssen sie gefesselt werden; aber sie strampeln sich gewissermassen zu Tode, denn kein — noch zumal durch ein durch das Trauma geschädigter — Kreislauf kann diese Motorik ertragen. Wo SEE und Evipan nicht ausreichen, haben wir die Avertinnarkose angewandt, in gleicher Weise wie in der Behandlung des schweren Tetanus. In wenigen Fällen gelang es dadurch eine Entlastung des Kreislaufes zu erzielen, die eine Heilungsmöglichkeit eröffnete und der dann eine wesentliche Besserung des Allgemeinbefindens folgte.

Bei allen schwereren Hirnverletzungen steigt der systolische wie diastolische Blutdruck nach etwa 24 Stunden an. In den zum Tode führenden Fällen blieb der Blutdruck bis kurz vor dem Exitus auf dieser Höhe, während die prognostisch günstiger verlaufenden Fälle in der zweiten Hälfte der ersten Woche ein Absinken des Blutdruckes, in den meisten Fällen bis unter die Norm erkennen liessen. Erst nach einer oder mehreren Wochen erreichten die Blutdruckwerte wieder normale Höhe. In den meisten dieser Fälle ergab das Electrocardiogramm Coronardurchblutungsstörungen ungewöhnlichen Ausmasses, die in allen günstig verlaufenden Fälle zurückgingen. Auffallend war ferner ein ungewöhnlich hoher Alkaligehalt des Harnes, mit dem wahrscheinlich auch eine sehr ausgedehnte Andauung der Magenwand in einigen Sektionsfällen in Verbindung gebracht werden muss.

Viele dieser Fälle von ausgedehnten Quetschungen des Gehirns gehen einher mit ausgedehnten Blutungen. Je nach dem Ausmass der Blutung lassen sie Hirndruckerscheinungen erkennen. Zumeist wird hier die Therapie machtlos sein.

Das Ergebnis der Infektionsprophylaxe.

Die Wirksamkeit dieses Vorgehens läßt sich am besten an den unkomplizierten Impressionschüssen mit Duraverletzung und verlegter Knochenlücke darstellen. Die Misserfolge sind hier allein durch intradurale Infektionen gegeben, da alle Fälle von ausgedehnter Quetschung des Gehirns, Blutungen, primäre Ventrikelöffnungen ausgeschaltet sind. Für solche kritischen Nachprüfungen eignet sich das Material einer hirnehirnchirurgischen Bereitschaft, dass im Monat durchschnittlich 150—170 intradurale Hirnschüsse beträgt, besser als grosse Sammelstatistiken.

Die bakteriologische Untersuchung der frischen Hirnwunden, die wir bei einem Einsatz mit Hilfe einem, einer hirnehirnchirurgischen Bereitschaft für diesen Zweck zugeteilten Feldlabors vornehmen konnten, ergab in 85.5 % einen positiven bakteriologischen Befund in der Tiefe der Hirnwunde.

Um Beurteilungsfehlern aus dem Wege zu gehen, wurden für die Kritik der Wundversorgung nur bakteriologisch positive Fälle ausgewertet.

Das Behandlungsergebnis wird durch folgende Tabelle wieder gegeben.

Aus dieser Zusammenstellung ergibt sich zunächst einmal das p. p.-Heilungen in der Hirnwunde bei einer bis zum 6. Tage nach der Verwundung ausgedehnten Versorgung noch bis zu 85 % erzielbar sind. In der Weichteilwunde trat dagegen eine p. p.-Heilung nur in Zweidritteln, bis zu einem Fünftel der Fälle ein,

Tabelle 1.

Heilungsergebnis bei 66 unkomplizierten Impressionschüssen mit positiven bakteriologischen Befund in der Hirnwunde.

Versorgung am:	Zahl	p. p.	extradurale Infektion	intradurale Infektion	+ an Meningitis	Aus anderen Ursachen +
1. Tag	3	3	—	—	—	—
2. Tag	16	6	9	1	1	3
3. Tag	18	6	8	4	3	1
4. Tag	12	3	5	3	3	—
5. Tag	11	3	6	2	1	—
6. Tag	6	1	5	—	—	—
	66	22	34	10	8	4
		56 (84,8 %)		(15.1 %)	(12.1 %)	

zum 6. Tage hin abnehmend. Einer intraduralen Infektion erlagen aber nur 12 %. Daraus geht eindeutig hervor dass der primäre Verschluss der Dura für das Endergebnis wichtiger ist als der Verschluss der Weichteile, Diese Tatsache hat bisher noch keine allgemeine Anerkennung gefunden. Selbst der fanatischen Vorkämpfer des primären Wundschlusses im ersten Weltkriege BARANY hat zwar den Vorschlag JEGERS, die Duralücke durch ein Transplantat aus der Fascia lata zu schliessen, gelegentlich ausgeführt, diese Massnahme jedoch nicht als die entscheidende erkannt. Bei den offenen Friedensverletzungen waren KÖRTE und ENDERLAN wohl die ersten, die eine Duralücke durch ein Fascientransplantat verschlossen haben. Besser als die Verwendung des ausser Blutversorgung befindlichen Transplantates ist aber sicherlich unser Vorgehen zum Verschluss der Duralücke, bzw. zur Sicherung der Duranaht, einen gestielten Galeaperiostlappen zu verwenden. Auch diese Methode hat ihre Vorläufer in dem periostalen Visierlappen von FREY und BÜTTNER aus dem ersten Weltkrieg, die ihn zur Verhütung, bzw. zur Deckung eines Prolapses empfahlen. Diese Methode ist neuerdings von RIECHERT wieder empfohlen worden. Interessant ist in diesem Zusammenhang, dass bereits damals FRANZ die hier für die Hirnschüsse entwickelte Beobachtung, dass für die Behandlung perforierender Schussverletzungen der Körperhöhlen der Verschluss der die Höhlen abgrenzenden Membran wichtiger ist, als der Verschluss der sie bedeckenden Weichteile, für die Gelenkverletzung bekannt gegeben hat.

Vergleichen wir mit dem Ergebnis der Versorgung dieser 66 unkomplizierten Impressionsschüsse das Schicksal von 96 unzureichend versorgten unkomplizierten Impressionsschüssen mit Duraröpfung ohne Prolaps, bei denen Knochen oder Metallsplitter zurückgelassen waren, oder bei denen das Fehlen eines Saugers die radikale Ausräumung der Hirntrümmer unmöglich machte, so ergibt sich das Folgende:

Tabelle 2.

Heilungsergebnis bei 96 unzureichend versorgten unkomplizierten Impressionsschüssen mit Duraverletzung ohne Prolaps.

Zahl	p. p.	extradurale Infektion	intradurale Infektion	+
96....	15	21	60	35
		36	(62.5 %)	(36.4 %)
		(37.4 %)		

Berücksichtigt man, dass die bakteriologischen Befunde der Hirnwunde in diesen Fällen nicht bekannt sind und also zum Vergleich die bakteriologisch negativen nicht ausgeschaltet werden konnten, so stehen 15.1 % intradurale Infektionen infolge der unzureichenden Ausräumung der Hirnwunden 62.5 % und 12.1 % Todesfälle 36,4 % entgegen.

Diese Gegenüberstellung lässt an der Bedeutung der sorgfältigen Ausräumung der Hirnwunde wohl kaum einen Zweifel aufkommen.

Primäre Ventrikeleröffnung.

Mit Recht gefürchtet ist die dritte Komplikation der Impressionsschüsse, die in gleicher Weise die Steeckschüsse betreffen kann, die *primäre Eröffnung der Ventrikel und der grossen Zisternen*. Das klinische Geschehen ist allen Frontchirurgen bekannt. Am 5. spätestens am 6. Tage nach der Verwundung steigt bei dem bis dahin oft verhältnismässig störungsfreien Verlauf die Temperatur auf 40 Grade und mehr. Der Verwundete wird zunehmend mehr benommen und deliriert. Das Gesicht zeigt die eigentümliche Mischung von Fiebertöte und Zyanose, die wir als Kupferfarben bezeichnet haben. Ende der ersten, Anfang der zweiten Woche erfolgt gewöhnlich der Exitus an Meningitis. CUSHING hat aus den Erfahrungen des ersten Weltkrieges die Mortalität für die Eröffnung des Ventrikels durch metallische Stecksplitter mit 100 % die durch Knochensplitter mit 42.7 % angegeben.

Die Erörterung dieses Problems sei wiederum am Material einer hirnchirurgischen Bereitschaft dargestellt, das wir vermöge unserer Organisation genügend lange beobachten könnten um es hinreichend beurteilen zu können.

Tabelle 3.

*Einsatzstatistik einer hirnchirurgischen Bereitschaft
der Luftwaffe:*

Monat	Zahl der operierten intraduralen Hirnschüsse	Zahl der Ventrikeleröffnungen	Mortalität
Juli	128	51	48 (37.5 %)
August	151	79	24 (15.9 %)

Tabelle 4.

Heilungsergebnisse bei primären Ventrikeleröffnungen

nur allgemeine Sulfonamidbehandlung			ausserdem örtliche Behandlung mit M. P. Puder			Örtliche und allgemeine Sulfonamidbehandlung u. frühzeitige Liquorausblasungen.		
Zahl	+	%	Zahl	+	%	Zahl	+	%
26	20	76.9 %	26	11	44 %	79	18	22.7 %

In einem Monat wurden bei dieser Bereitschaft 51 Ventrikeleröffnungen operiert, von denen 31 (61 %) starben. 26 Fälle wurden in der beschriebenen Weise operiert und mit Sulfonamiden nachbehandelt; es starben 20 (77 %). 25 Fälle wurden ausserdem mit örtlicher Marfanil-Prontalpin-Therapie bedacht, davon starben 11 (44 %). Im nächsten Monat wurde dazu noch die frühzeitige Meningitisprophylaxe durchgeführt. Sobald die Zellzahl im Liquor über 300/3 stieg, wurde die bei uns übliche Meningitisbehandlung mit Ausblasung des Liquors nach Zeller, Kreislaufstützung oder -behandlung neben der Sulfonamidtherapie durchgeführt. Das Ergebnis war: Von 79 Fällen starben 18 (23 %). Dieses Ergebnis legt den Gang der zukünftigen Behandlung der Ventrikeleröffnungen fest. Wohl selten haben wir die Möglichkeit einer so klaren Entscheidung.

Steckschüsse.

Kurz sei noch auf die Versorgung der Steckschüsse eingegangen.

Eine Beobachtung von 256 nur am Einschuss versorgten Fälle über etwa 2 Jahre ergab, dass in über 40 % mit einer intraduralen infektiösen Komplikationen gerechnet werden muss. Deshalb bemühen wir uns, den Stecksplitter bei den ersten Versorgung zu entfernen. Das gelingt bei einiger Übung leicht von der Einschusswunde aus, wenn der Splitter noch im Schusskanal sitzt. Liegt aber ein innerer Prellschuss nach Payr vor, so kann man ihn nur von einer zweiten Trepanation aus entfernen, die wir dann nach Ablauf der ersten Woche durchführen.

Schluss.

Das Gesamtergebnis dieser Behandlung lässt sich in einer ersten Serie von 929 Hirnschussverletzten in tab. 5 wiedergeben.

Tabelle 5.

Heilungsergebnis bei 929 Hirnschussverletzten.

Von 929 Hirnschussverletzten starben	310	33,4 %
starbend eingeliefert wurden:	28	
aus anderer Ursache verstorben sind:	45	
davon an Pneumonie	29	
allgem. Infektion	6	
Thoraxverletzung	3	
Halsverletzung	2	
Gasbrand	1	
Tetanus	1	
Embolie	1	
Rückenmarksverletzung	1	
	45	73
929	310	
— 73	— 73	
856	237	(27,6 %)
davon an Meningitis gestorben	191	(84,8 %)
(Abszess und Encephalitis)		
Hirndrucksteigerung	46	(15,2 %)
Die 619 Überlebenden wurden bis zum 1.4.1942 aus dem Heimatlazarett entlassen:		
pflegebedürftig		13,3 %
arbeit- oder wehrdienstfähig		53,3 %

Ein Vergleich mit dem ersten Weltkrieg ist schwer möglich, da aus damaliger Zeit keine Beobachtungen über den vollständigen Heilungsablauf vorliegen. Nur WAGSTAFFE und BOIT können über längere Beobachtungen berichten: Mortalität: 55,7 und 61,5 %. BORCHARDT gab die Gesamtmortalität mit 75—80 % an. Sie dürfte die Verhältnisse vielleicht am richtigsten wiedergeben. Dennoch wäre die Mortalität um mehr als die Hälfte gesenkt worden. 53,3 % der vom Hauptverbandsplatz kommende Hirnverletzte kann also damit rechnen, dass er sich in irgendeiner Form sein Brot wieder selbst verdienen kann.

Zusammenfassung.

In früheren Arbeiten wurde zur Behandlung der Hirnschüsse in der Zeit vom ersten bis sechsten Tage nach der Verwundung die radikale Ausräumung der Hirnwunde nach Excision der Weichteilwunde und Erweiterung der Knochenlücke mit nachfolgendem

to prevent to a considerable extent the development of toxic meningitis.

III. *Intracranial hematoma.* Subdural empyemas occur through the infection of subdural hematomas. Prophylactic exploration of the subdural space for hematoma at the primary treatment of the wound greatly improves the prognosis of cases of this type. Arterial hemorrhage necessitates early treatment. Extradural lesions of the carotid artery call for ligature of the internal carotid artery in the neck and intracranial ligature immediately below the optic nerve. 3 cases of intradural and 5 cases of extradural hemorrhage from the carotid artery were successfully treated. Of 6 cases of hemorrhage from the anterior cerebral artery, 2 died, and of 7 cases of hemorrhage from the middle cerebral artery, 4 died of pneumonia.

IV. *Extensive contusions of the brain.* The majority of cases presenting this form of injuries die from the effect of disturbances of the central vegetative regulation system. Observation of these cases throw additional light on injuries of the brain stem (commotio).

V. *Primary lesion of the ventricles.* Local and general sulfa-therapy and early drainage of the cerebrospinal fluid together with the routine surgical treatment of the brain wound lowered the mortality rate from 76.9 per cent to 22.7 per cent.

VI. *Gunshot wounds of the brain with retained missile.*

256 cases of this type were followed for a period of 2 years. Intradural infection followed in 40 per cent of the cases. Early removal of the missile is therefore indicated and the best results will be obtained if the splinter is removed at the first treatment of the wound.

VII. The fate of the first series of 929 individuals with gunshot wounds of the brain is shown in Table 5. The mortality rate was 33.4 per cent (operative mortality 27.6 per cent). 55.3 per cent of the cases were able to return to their former occupation or former service in the army. 13.3 per cent were invalids needing further care.

Résumé.

Dans des travaux antérieurs l'auteur a recommandé, pour traiter les coups de feu du cerveau pendant la période du premier au sixième jour après la blessure, de débayer radicalement la

plaie cérébrale après excision de celle des parties molles et élargissement de la brèche osseuse, sur quoi l'on pratique une fermeture étanche de la dure-mère au moyen d'un lambeau pédiculé comprenant la galéa et le périoste et l'on suture la plaie des parties molles par des points séparés au catgut sur un drain de caoutchouc souple.

Dans le présent travail il fait un rapport critique sur les résultats de cette méthode.

1. *Prévention de l'infection de la plaie cérébrale.* Pour l'étude des résultats il a utilisé 66 cas de coups de feu pénétrants non compliqués avec constatations bactériologiques positives dans la profondeur de la plaie cérébrale. Il n'apparut que dans 15.1 % des cas une infection dans la plaie du cerveau. 12.1 % moururent de l'infection intra-durale.

Il les a comparés à 96 cas semblables de coups de feu pénétrants non compliqués, avec ouverture de la dure-mère sans prolapsus, qui n'avaient pas été traités d'une façon suffisante et chez qui on avait laissé des esquilles osseuses ou des éclats métalliques: infection intradurale dans 62.5 %, mortalité 36.4.

2. *Prévention de l'infection des espaces sous-arachnoïdiens.* Toute méningite est précédée d'un stade de «réaction méningée» avec augmentation du chiffre des leucocytes dans le liquide céphalo-rachidien. Par une observation continue des caractéristiques du liquide céphalo-rachidien on réussit à reconnaître précocement ces modifications qui représentent le stade préliminaire, non toxique, de la méningite. En expulsant chaque jour le liquide céphalo-rachidien par des insufflations d'air et grâce au traitement par les sulfamidés dans les cas où le chiffre des cellules s'élève au-dessus de 300/3 on réussit dans une très large mesure à empêcher le passage vers la méningite toxique.

3. *Hématomes intracrâniens.* Des hématomes sous-duraux proviennent les empyèmes sous-duraux. C'est seulement depuis que l'on recherche préventivement les hémorragies dans l'espace sous-dural que le pronostic de ces cas s'est modifié. Les hémorragies artérielles réclament des interventions très précoces. Les lésions extradurales de la carotide rendent nécessaire la ligature de la carotide interne au cou et à l'intérieur du crâne près du nerf optique. Trois hémorragies intradurales et cinq extradurales de la carotide purent être traitées avec succès. De 6 cas d'hémorragie par l'artère cérébrale antérieure 2 moururent, et de 7 par l'artère cérébrale moyenne 4 décédèrent, de pneumonie.

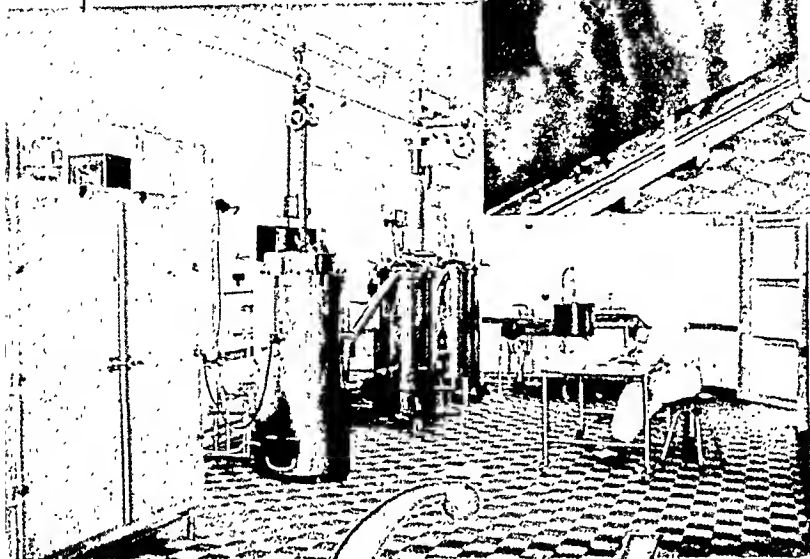
4. *Les cas de lésion du cerveau avec contusion cérébrale étendue* meurent pour la plupart à cause des troubles de la régulation centrale. Chez eux on a pu faire des observations instructives pour la compréhension des atteintes du tronc cérébral (commotion).

5. *Ouverture primitive des ventricules.* Grâce au traitement local et général par les sulfamidés, et grâce à l'expulsion précoce répétée du liquide céphalo-rachidien par des insufflations, sans préjudice du traitement chirurgical ordinaire, la mortalité a pu être abaissée de 76.9 % à 22.7 %.

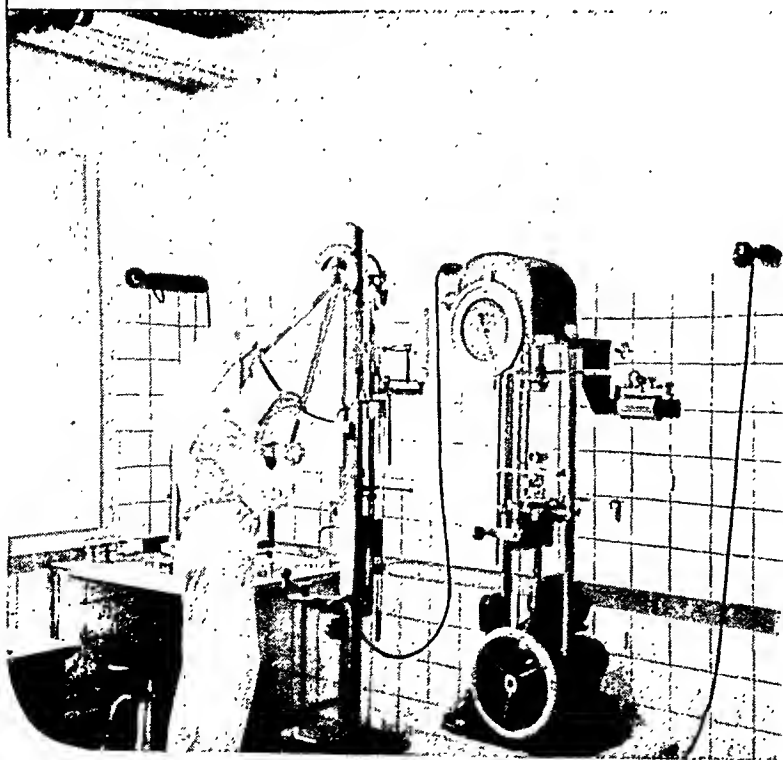
6. *Projectiles inclus.* L'observation, pendant deux ans, de 256 blessés porteurs de projectiles a montré l'existence d'une infection intradurale dans plus de 40 % des cas. Aussi l'extraction précoce du fragment est-elle indiquée, et de préférence elle doit se faire immédiatement lors du premier traitement chirurgical.

7. Le sort d'une première série de 229 blessés du cerveau ressort du tableau 5. Mortalité, 33.3 % (mortalité opératoire 27.6 %). Récupération de la capacité de travail et de l'aptitude au service armé, 53.3 %. Enfin 13.3 % des cas sont justiciables des soins médicaux.

ASTRA



Cartgut -
SVENSK TILLVERKNING



(From the Surgical Department of the St. Göran Hospital,
Stockholm.

Chief Surgeon: Prof. A. TROELL.)

On the Operative Therapy and Prognosis in Fracture of the Patella.

By

ERIK MOBERG.

This investigation is directed to obtaining a clearer conception of the prognosis in operatively treated fractures of the patella, especially as regards the possible development of troublesome arthritis deformans following fracture and operation, and at the same time to inquire into those factors connected with fracture form and treatment which may lead to unfavourable results. The inquiry has given rise to certain suggestions respecting operative method and the purpose intended by it.

A rather comprehensive report based on follow-up examinations has already been published in Sweden by TROELL (1913) on the treatment of fractures of the patella and its results, chiefly maintaining the advantages of operative therapy as compared with the conservative treatment often employed earlier. JÄRVINEN (1942) has recently published a rather large Finnish material. As the latter work gives a detailed historical review with careful references to the rich literature on the subject up to the preceding year, only a few of the more important works of recent years will be mentioned in the present paper.

Only those forms of patellar fractures which require operative treatment will be dealt with here. As regards the indications for operation there would now seem to be rather good agreement. The principal indication is *defective extensor mechanism*.

With a view in the first place to showing how the permanent results of operative therapy in patellar fractures present themselves in an insurance material collected from the whole country an analysis has been made of the material of Riksförsäkrings-

anstalter (National Insuree Office) for the six years 1918—1923. However, the conclusions drawn from the investigation are mainly based on follow-up examinations of clinical material, viz. the cases of fractured patella operated on at the St. Göran Hospital in Stockholm since the surgical department was opened there in 1930. In addition, attention has also been directed to material from other hospitals, especially from the surgical department of Sahlgren's Hospital in Gothenburg (Chief: Prof. SVEN JOHANSSON) and the surgical clinic of the University of Lund (Chief: Prof. J. STRÖMBECK).

Insurance Material.

During the period 1918—1923 fractured patellae to a number of 104 were certified to the National Insurance Office as due to accidents at work, and 44 of them had been treated operatively. Only the latter will be discussed here. The injuries collected from these years date so far back in time that the results can now be regarded as essentially permanent. In some cases the records of the Office were sufficient for this investigation of the late results, in others supplementary data have been kindly supplied by several hospitals in the country.

The primary postoperative mortality was nil. The stay in hospital amounted on an average to 53 days. Full insurance-money was paid for an average of 133 days, after which partial sick-pay was made, so that on the average 164 days elapsed before full-time work had been resumed or the injury had been settled by a life annuity. No patients were capable of returning to work within a shorter period than 2 months. In 18 cases, i. e. 41 %, there remained at the cessation of certification a certain amount of incapacity, which was however written off in 6 cases after an average 1 year 9½ months. None the less, permanent incapacity estimated to average 21 % remained for no fewer than fully one-fourth of the operatively treated cases. In two of these the disablement amounted to 50 %. One was a bilateral fracture with a considerable permanent limitation of the extensor capacity, in the other a secondary rupture of the extensor mechanism had arisen. The causes of permanent incapacity in the rest of the cases belonging to this category were secondary rupture of the suture (1 case), pseudarthrosis (1 case), extensor defect of other origin

(2 cases), distress due to angulation between the fragments (1 case), arthritis deformans (3 cases), age, etc.

These figures, accordingly, are derived from an old material collected from the whole country and consist exclusively of insurance cases, chiefly among persons of the labouring classes. The operations date rather far back in time, and the material must be considered as representative of the average healing results during the period stated and for the clientele mentioned. However, as other methods of treatment than those then employed have not been subsequently applied at our hospitals to any considerably extent, the average present-day results would probably not be substantially different. Of course, the results from more favourably selected material and from special departments are considerably better. Reference may be made, for instance, to the 100 cases operated upon at the Red Cross Hospital (1932—1941) and Maria Hospital (1930—1939), Helsingfors and published by JÄRVINEN (1942). Their complete average absence from work amounted to about 76 days. Undoubtedly, however, the series of results mentioned also show that a fractured patella with defective extensor mechanism is a serious injury and one in which patients even of a relatively young age have to expect a not inconsiderable risk of incapacity. The material analysed affords, however, but few criteria for judging why certain cases heal well and others leave a disablement of this kind.

Clinical Material.

In order to investigate this point more closely, as well as to study how a series of patients from one of our larger special surgical departments has developed after breaking contact with the hospital, the investigation has been prosecuted with a follow-up examination of patellar fractures operated on at the St. Göran Hospital in Stockholm.

The material consists of 23 operatively treated fractures of the patella. Two of the patients have since died, but in these instances reliable information as to knee function has been procured. The other 21 have all been traced and re-examined. On account of old age one of these had not returned to work of any kind after the operation and, psychically completely lost, had entered a home for the aged. All the rest have also been subjected to a thorough

X-ray examination (by the courtesy of the Roentgenological Department of the St. Göran Hospital. Chief: Dr. N. WESTERMARK, M. D.). The follow-up examination can therefore be regarded as complete.

The essential data for the material examined have been tabulated (Table I).

Table
Fractures of the Patella operatively

Case No.	Age at time of fracture	Operative method	Days in hospital	Days under treatment	Incapacity (Stated only for insurance cases)		Follow-up examination after years
					Temporary	Permanent	
1	27	Catgut cerclage	38	131	0	0	11
2	44	Aluminium-bronze cerclage	62	151			11
3	27	Catgut cerclage	8	145	10-15% 1 1/2 yr.	0	11
4	33	Aluminium-bronze cerclage	16	234	10% 1 yr.	0	10
5	24	"	55	167			9
6	37	"Wire" cerclage	55	130	50% 23 d.		8
7	43	Aluminium-bronze cerclage	24	134	10% 1 1/2 yr.	0	7
8	55	"Wire" cerclage	11	46	10% 150 d.	0	6
9	55	Aluminium-bronze cerclage	24	173			6
10	53	"	54	144			5
11	69	"	(120)	—			5
12	46	"	8	.	0	0	5
13	66	"	45	130	12% 500 d.	0	4
14	62	"Wire" cerclage	19	90			3

It will be seen that the majority were treated by the cerclage method, a few of the cases by suture through drill-holes. For most of those operated on during the earlier years aluminium-bronze wire was used. In 3 cases the suturing material was catgut, in a case here and there it was silkworm gut or stainless steel wire (later cases). One operation led to infection of the knee-joint, the

I.

treated at the St. Göran Hospital.

Follow-up Examination			Occupation		Comments
Power of active movement in knee-joint		Circumf. of thigh compared with uninjured side cm			
Ex-tension	Flexion (Bracketed values refer to uninjured knee)		Before	After	
Normal	130 (145)	—1	Plank-carrier	Labourer	Flexion only 70° till 4 yrs after op., when pat. fell and at once got range of flexion now stated. Previous fracture of femur of same leg, healed with 4 cm shortening.
Cannot be judged owing to other fresh injury		—	Housewife	Same oc.	
Normal	120 (135)	—2	Lorry-driver	Same	
Normal	140 (150)	0	Housewife	"	
Normal	100 (150)	(—5)	Builder's workman	"	
—2°	130 (140)	—2	Gasworks employee	"	
Normal	135 (140)	+1	Builder's foreman	"	
Normal	140 (140)	—0	Plumber	"	
Normal	125 (130)	—2	House-wife	"	
Normal	100 (140)	—2	Official	"	
—5°	45 (125)	—	Spinster	"	Concurrent fracture of femur and leg on same side, complicated fr. of patella
Normal	130 (140)	—	Merchant	"	
Normal	110 (135)		Widow	"	
Normal	140 (140)	0	Taxi-driver	"	

Case No.	Age at time of fracture	Operative method	Days in hospital	Days under treatment	Capacity (Stated only for insurance cases)		Follow-up examination after Years
					Temporary	Permanent	
15	53	Aluminium-bronze cerclage + bone graft	(70)	201 (?)			Dead
16	12	Fixation with silk	85	247			2½
17	46	"Wire" cerclage	31	193	0	0	2½
18	41	Stainless steel wire cerclage	35	?			2
19	73	Aluminium-bronze cerclage	51	—			Dead
20	27	Fixation with silkworm gut	19	113			1½ (3) ¹
21	54	"Wire" cerclage	39	80			1½ (2½) ¹
22	31	Catgut cerclage	32	127	50% 20d.	0	½ (2) ¹
23	37	Fixation with silk and catgut through drill-holes	70	134	0	0	½ (1½) ¹

¹ According to later inquiry is the functional result still unchanged.

other cases healed by first intention. There was no primary mortality. Secondary rupture of the patella after osteosynthesis did not occur. Union of the bone was achieved in all the cases except two, in which, however, the fibrous union in one case led to a functional result which was in no way inferior to that attained in the cases with a bony union. The second was an inveterate fracture in a tabes case. No union was obtained.

In all except one case the follow-up examination has been performed personally by the author, the anatomical and functional results both being carefully studied.

Follow-up Examination			Occupation		Comments
Power of active movement in knee-joint	Flexion (Bracketed values refer to uninjured knee)	Circumf. of thigh compared with uninjured side cm			
Ex-tension			Before	After	
—	—	—	Locomotive fireman	0	Advanced tubes at time of fr. Old fr. on adm. to hospital. Suicide 3 yrs later. At that time walked with pain. Pseudarthrosis.
—5°	150 (170)	—5	At school.	Same occ.	Pyarthrosis.
Normal	125 (145)	—1	Builder's workman	Warehouse assistant	Could not continue carrying bricks
Normal	115 (145)	0	Warehouse assistant	Same oc.	
—	—	0	In home for the aged	"	Till 2 years after op. had difficulty in walking
Normal	120 (130)	0	Waitress	"	
Normal	115 (150)	—2	House-wife	"	
Normal	140 (145)	—1/2	Gardener	"	
Normal	110 (145)	—	Painter.	Labouring wk in spare time Same oc.	

At the follow-up examination special importance has been attached to getting a conception of how the posterior surface of the patella appears, how the femoro-patellar joint presents itself, and to what extent arthritic changes have developed in the injured knee-joint. The X-ray examination has therefore included both knee-joints, and frontal, lateral as well as oblique views have been taken, in addition to which the femoro-patellar joint has been specially examined by Knutsson's technique (case 12 excepted).

Rather stringent requirements have been applied in judging the results. Thus, when a patient has stated, e. g. "I feel no differ-

ence between the two knees", "I never think of it", or "it feels a little tight when I have been sitting for a long time with my knee bent", etc., the result has been considered as fully satisfactory provided he has been able to resume his previous work in full as well as engage in leisure occupations. Among the less good results have been classed those cases in which the patient had to abandon his pre-accident occupation in order to go over to lighter work, or had not been able to move so freely as before, or otherwise has complained of real inconvenience. A detailed account of the healing time, incapacity, etc. would probably not give more representative values on account of the relatively small size of the material, and for these figures reference may be made to the table. Among the ten insurance cases no permanent incapacity occurred.

As mentioned, however, the investigation has been primarily directed to ascertaining why a number of cases have been fully restored while others have been burdened with lasting defects of a more or less serious nature. In this connexion certain results are of no interest, e. g. those having reference to very senile persons or to patients with severe concurrent injuries of another kind, etc., and such cases have therefore been omitted, viz. the following:

Case 11. Concurrent fracture of the femur, tibia, and fibula on the same side. High age.

Case 13. High age with senility.











Case 15. Advanced tabes, inveterate fracture.

Case 16. Post operative pyarthrosis.

Case 19. High age with considerable senility.









The remaining 18 cases have been divided on the principles laid down into those which have healed without notable restriction of function (10 cases, Table II) and those which have healed with a distinct reduction of function (8 cases, Table III). The sketches at the top of the tables show the appearance of the fracture as indicated by the X-ray pictures before the operation (in case 20 there was no such X-ray examination), while those beneath show the primary result of operation, also judged in figures. The figures below the sketches indicate the status at the follow-up examination at a specified time after operation, 1 denoting practically normal conditions, 2 and 3 increasing degree of morbid changes. It is quite clear that the typical cases of *good functional late results* collected in Table II are obtained under two circumstances viz.

Table II.
Fracture of the Patella Healed without notable Restriction of Function.

N u m b e r	2	6	7	8	12	14	18	20	22	23
Fracture, before operation ¹										
Primary result of operation as regards reposition of posterior surface of patella	1	1	3	1	2	2	2	3	1	1
Follow-up examination.										
Number of years later	11	8	7	6	5	3	2	1 ¹ / ₄ (3) ⁴	1 ¹ / ₂ (2) ¹	1 ¹ / ₂ (1 ¹ / ₂) ⁴
Result of follow-up examination.										
a) Posterior surface of patella	1	1	1	1	2	1	2	2	1	1
b) Deforming arthritis in the femoropatellar joint	1	1	1	1	2	1	2	2	1	1
c) Arthritic changes in the rest of the joint (beyond those present on the uninjured side)	1	1	1	1	2	1	1	1	1	1

¹ All sketches direct from the X-ray pictures and, for perspicuity, facing the same direction. The figures refer to the pathological changes as follows: 1 = none or small. 2 = moderate. 3 = serious.
² No pre-operative pictures taken. Both pictures show the state after the operation.
³ No picture taken immediately after the operation. The sketch is from a picture taken at a follow-up examination.
⁴ According to later inquiry the functional result is still unchanged.

Table III.
Fractures of the Patella Healed with Restriction of Function.

N u m b e r	1	3	4	5	9	10	17	21
Fracture, before operation ¹								
Primary result of operation as regards reposition of posterior surface of patella	3	3	2	3	3	2	3	2
Follow-up examination								
Number of years later	11	11	10	9	6	5	2 1/2	1 1/2 (2 1/2) ²
Result of follow-up examination								
a) Posterior surface of patella	3	2	2	3	2	2	3	3
b) Deforming arthritis in the femoropatellar joint	3	2	1	3	3	1	2	2
c) Arthritic changes in the rest of the joint (beyond those present on the uninjured side)	2	2	2	2	2	1	2	2

¹ All sketches direct from the X-ray pictures and, for perspicuity, facing the same direction. The figures refer to the pathological changes as follows: 1 = none or small. 2 = moderate. 3 = serious.

² According to later inquiry the functional result is still unchanged.

(1) when *the reduction of the fracture has been almost exact*, (2) *when the fracture is located within the lowest part of the patella*, in which case the fracture does not seem to affect the "active" articular surface to any noteworthy extent. Thus, even in cases of defective replacement, arthritic changes do not usually develop to any troublesome extent. Case 20 was not reduced so well; however, so short a period has passed since the operation that subjective arthritic symptoms may have not had time to develop. Both subjective and objective arthritic changes are likely to appear later, and hence the case will probably come into the next group.

Table III contains patellar fractures that have *not healed with a fully satisfactory result* but where pain, incapacity or other trouble still exist. The sketches compared with those in the preceding table show a distinct difference: the posterior surface of the patella is markedly uneven, often exhibiting a ridge. In these cases the femoro-patellar joint also shows much grosser arthritic changes, and often a considerably reduced cartilage space. Examples of this are presented by cases 1 and 3 (see Fig. 1). As a rule, the arthritis-deformans changes are considerable in the whole knee-joint as soon as several years have elapsed after the injury.

Points Relating to the Technique of Reduction and Osteosynthesis.

The following conclusions may be drawn from the results furnished in these tables. To ensure a fully satisfactory results operative treatment of a fracture of the patella must *aim to an equal degree both at the easier task of restoring the quadriceps extensor mechanism and the considerably more difficult one of restoring the articular surface of the patella*, this in order to avoid abnormal wear and deformation of the femoro-patellar joint as well as arthritis deformans in the knee-joint with its grave functional consequences. The latter task is not sufficiently heeded in current surgical handbooks and publications, and is most frequently not mentioned at all. There are, however, exceptions. For instance, WATSON-JONES (1940) points out that "special care must be taken not only to close the gap between the fragments but to fix them in such accurate apposition that no ridge remains on the articular surface". The patho-anatomical process that attends continuous cartilage abrasion in a joint has been

recently very clearly demonstrated by GELLERSTEDT-HULTÉN (1940). An uneven patellar surface, therefore, as known, involves risk not only for the femoro-patellar joint but for the whole knee-joint.

Replacement of the articular surface on the patella is greatly facilitated by a simple procedure which, so far as I have found, has not been mentioned in the literature. This consists in controlling and supporting the replacement during the whole operation with a finger introduced into the joint under the patella, either through the existing rupture in the parapatellar extensor mechanism or, if this is not large enough, through a longitudinal medial arthrotomy a couple of centimetres long. The leg should then lie in normal hyperextension of a few degrees. The gap in the extensor mechanism is not closed until osteosynthesis is completed with good results palpable from below. In this way it is often possible to obtain a good reduction even in severe crush fractures with many fragments. The three cases in which the writer has applied this technique are described in Table IV. It should be especially stressed that in most forms of fractures, if the reduction has been controlled only judging from the anterior surface of the patella, nothing at all will be known as to how the important posterior surface looks. It is self-evident that this is the case with the occasionally employed technique (SCHULTZE's) of suturing only the parapatellar extensor mechanism. BÖHLER's method of pressing the patella against the articular surface of the femur likewise gives results that cannot be controlled during the operation, except radiologically. Even this method of control is not only so troublesome to perform that it is unlikely to be adopted often in practice but is also much less exact than direct palpation. As a matter of fact, if these two requirements are fulfilled, i. e. both the extensor mechanism and the articular surface of the patella are restored, the operative method used is no doubt of subordinate importance. Another very important requirement is that the large ruptures which most frequently occur in the extensor mechanism at the sides of the patella should also be well sutured.

Table II above showed that in fractures through the lowest part of the patella, i. e. below the articular surface or in its lowest part, exact replacement is not of such importance. Not infrequently, instead of osteosynthesis, extirpation of the little distal fragment can here be indicated, specially in complicated fractures. Fig. 2 illustrates an instance of this kind of complicated fracture of the

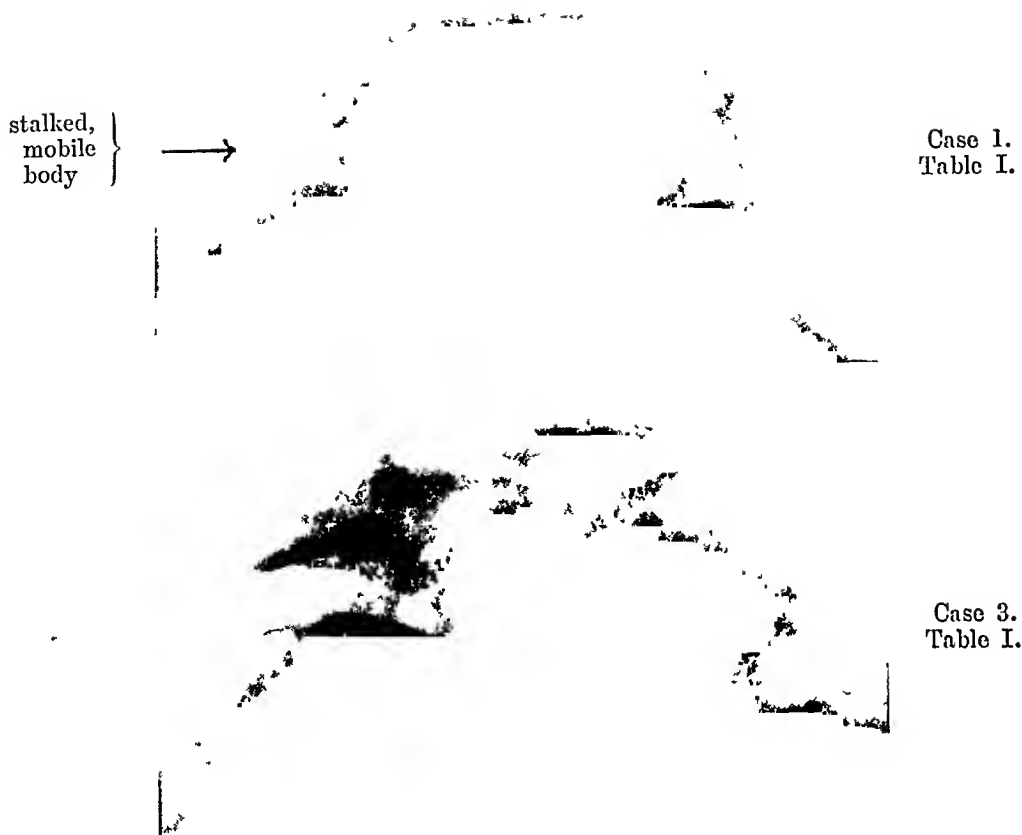


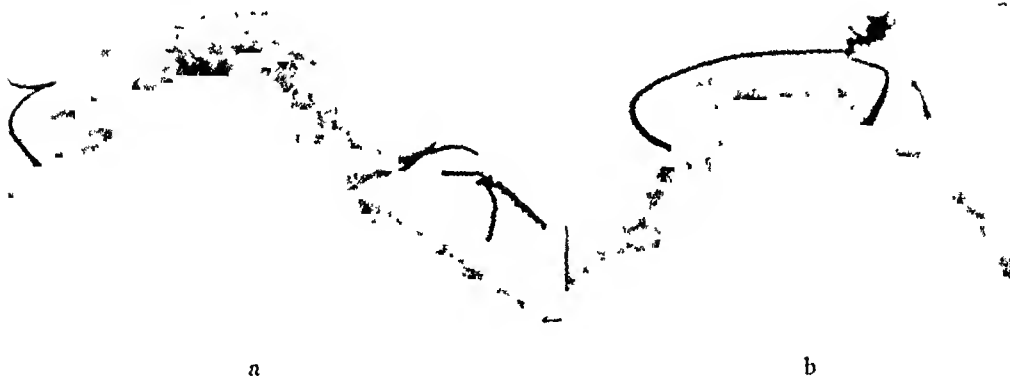
Fig. 1. Example of arthritis deformans of the femoro-patellar joint after operatively treated fracture of the patella. Note the uneven articular surface, mobile and stalked bodies, deposits.



Before operation.

2 years after operation.

Fig. 2. Complicated fracture operatively treated with suture of the extensor mechanism after extirpation of a lower fragment that involves only a very small portion of the articular surface.



a

b



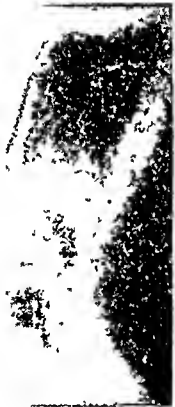



Fig. 3. Reactions on account of irritant approximation material (aluminium-bronze wire):

- a) Considerable vesiculation in bony structure of patella, zones of absorption, wire broken into several pieces.
- b) Powerful excrescences and areas of absorption round the wire, from which a small fragment has broken loose.

Cf. structure of patella in Fig. 1.

Table IV.

Fractures of the Patella Operatively Treated by Method of Reduction Specified (page 306).

Case	Before operation	Operation	After operation	Result
1.		Fixation by catgut cerclage		Insurance case. Permanent incapacity = 0. Besides gardening work does general labouring in spare time.
2.		Fixation by silk and catgut through drill-holes		Insurance case. Unemployed and passive, hence difficult after-treatment. Permanent incapacity = 0.
3.		Fixation by catgut through drill-holes + catgut cerclage		Insurance case. Permanent incapacity = 0. Pre-trauma work carrying sacks weighing 100 kg up ladder. Pat-resumed this work, but on two occasions thereafter had hydrarthrosis.

patella with extirpation of a conchoidal fragment, the line of fracture here cutting the articular surface. In complicated patellar fractures extirpation of an injured prepatellar bursa will no doubt reduce the risk of infection.

Fixation Material.

Widely varying material has been used at different times by different surgeons for osteosynthesis. Statements as to the advantages and disadvantages of the different materials have likewise varied. There has, however, been a distinct tendency of late in the direction of avoiding irritant material. WATSON-JONES, for instance, prefers catgut. Even in the last addition of BIER-BRAUX-KÜMMEL (1933) aluminium-bronze is recommended as a suitable material, although prominence is admittedly given there to the investigations of MADELEINER and PAAS as well as SCHULTZE, who have shown the unsuitability of irritant wire. JÄRVINEN does not deal with the question.

In the present follow-up investigation attention has also been given to the effect of the fixation material on the after-course (Table V). In 11 cases aluminium-bronze wire was used, and in 5 "wire" of an unspecified kind, this too probably aluminium-bronze in most of the cases. One or two described as "wire" may have reference to stainless steel, in fact in one case it has been definitely stated that such wire was used. Catgut was used four times, sometimes along with silk, silk was employed only once, and silkworm once. In no case does the fixation material seem to have had any bearing in one or the other direction on the consolidation of the fractures (secondary rupture has not occurred) or on the late result as regards the stability and mobility of the knee-joint.

Of the aluminium-bronze wires, over two-thirds had broken into pieces, in one case as many as six, while two after short time had to be removed on account of the trouble caused. In a case observed at Sahlgren's Hospital a fragment of this type of wire had entered the joint and caused severe distress that necessitated operative removal of the wire. Aluminium-bronze wire has had a distinct effect on the osseous structure of the patella, the structure having almost always become coarse-meshed or very vesiculated. This appears, however, less in the two cases (2 and 12) in which the wire had been removed on account of the distress caused, and

Table V.
The Effect of the Fixation Material.

Material used	Case No.	Examined after Years	Patella		Discomfort from fixation material
			Structure of bone	Anterior surface	
Aluminium-bronze wire.	2	11	Somewhat coarse-meshed	Slightly uneven	Wire removed 2 yr after op. while causing trouble.
	4	10	Vesiculated	Even	Stalked mobile body laterally against patella causes pain
	5	9	Vesiculated	Even	No trouble.
	7	7	Somewhat vesiculated	Uneven	No trouble.
	9	6	Vesiculated	Uneven	No trouble.
	10	5	—	—	Slight pain.
	11	5	Much vesiculated	Very uneven	No trouble.
	12	5	Normal	Distinct unevenness	Wire removed on account of ulceration, has pierced the skin
	13	4	—	—	—
	15	—	—	—	—
	19	—	—	—	—
"Wire" of non-specified kind	6	8	Vesiculated	Uneven	Discomfort when kneeling. Wire palpable.
	8	6	Coarse	Slightly uneven	No trouble.
	14	3	Normal	Somewhat uneven	No trouble.
	17	2½	Normal	Spongy, considerably changed	Pain when he knocks against something.
	21	1	Vesiculated	Uneven	Wire palpated. Mild pain.
	18	2	Normal	Even	No trouble. Stainless steel wire.
Non-metallic fixation material	1	11	Normal	Even	No trouble. Catgut.
	3	11	Normal	Even	No trouble. Catgut.
	16	2½	(Vesiculated)	Even	No trouble. Silk. (Post.op. pyarthrosis)
	20	1¼	A large vesicula	Even	No trouble. Silkworm.
	22	½	—	Uneven	No trouble. Catgut.
	23	½	Normal	Even	No trouble. Catgut and silk.

therefore everything seems to suggest a recession of the changes here. Stainless steel wire as well as non-metallie fixation material has not had this effect on the osseous structure of the patella. The unfavourable effect of aluminium-bronze wire was still clearer on the anterior and lateral surfaces of the patella. Distinct signs of irritation can often be observed here in the form of an absorption canal up to half a centimetre wide round the aluminium-bronze wire, and near that wire large spongy processes (Fig. 3), semi-fixed bodies or (in other material) even distinctly free bodies. In some cases these have caused typical symptoms of incarceration. Compare Table V and fig. 1. It is thus evident that aluminium-bronze wire is a fixation material that ought no longer to be employed and that catgut as well as other non-metallie material may be used, even though this demands somewhat more of the after-treatment technique according to the lower strength of the material. Probably — although this investigation does not give any information on the point — we have in stainless steel wire a relatively non-irritant material of great strength.

Extirpation of Patella.

So far in this paper attention has been directed only to operative treatment in which the patella — or at least the main part of it — is preserved, only these methods having been employed in the cases hitherto reported here. The treatment of fractures of the patella can no longer be discussed, however, without also taking up the question of extirpation of the patella.

This method has been used of late years as a primary one, especially in England, chiefly for crush fracture in which replacement has been considered difficult or impossible, but also generally in fractures of the patella that require operative treatment.

A brisk discussion was started on extirpation of the patella (Cf. FRIBERG, 1941) especially after BROOKE (1937) had published a series of follow-up cases treated by this method. The results are stated to have been extremely good, in certain cases the knee operated on is reported to have been even stronger than the sound one(!). The strength was tested, however, with the knee bent at about right angles, and in the majority of cases it is not clear whether full extension with good power had been obtained, which is the essential thing.

Several authors have endorsed BROOKE's view. WATSON-JONES (1940), for instance, considers the method suitable for certain cases, and there is no doubt that it can give relatively good results.

In Sweden extirpation of the patella has been used very seldom as a primary method of treatment. More frequent recourse has however been had to it in fractures treated with unfavourable results by other methods (FRIBERG 1941).

Primary extirpation of the patella has not been employed at the St. Göran Hospital, and the follow-up examination carried out there gives no data for judging the method. According to the writer's experience from material treated elsewhere, however, the results obtained by this method are by no means exclusively favourable.

Of the few cases observed by the writer of fractured patella treated with extirpation of the whole patella, some have been favourable, though in no case better than the better osteosynthesis cases. There has been some difficulty in attaining full extirpation with good power and, beyond this, that small degree of normal hyperextension which is so important for the full stability and tenacity of a knee-joint. On the other hand, two cases have led to a more unfavourable result than the least successful of the relatively many osteosynthesis cases the author has had an opportunity of observing.

One of these cases — operated on abroad — is cited here. The knee remains at 15° flexion and cannot be extended beyond that, but with pain can be actively flexed 10° . The injured patient suffers such great distress, and his working capacity is so greatly reduced, that resection of the knee-joint is indicated.

A contributive factor to the unfavourable result is no doubt that the extirpation had been performed subperiosteally, with the result that a considerable new-growth of irregular bony tissue as well as calcifications has arisen in the tendon.

What has been stated above shows that caution in the use of patellar extirpation as a primary method of treatment is of need until more experience of its operative technique and of its late results has been gained. The after-treatment cannot be carried out as routine and demands considerable active co-operation on the part of the patient.

Secondary extirpation of the patella may sometimes naturally enough be the only means of improving an unfavourable healing result after primary osteosynthesis.

Summary.

An analysis of the National Insurance Office material of fractures of the patella operatively treated during the years 1918—1923, 44 cases, shows, like similar previous analyses, that these fractures have a long after-course and carry a considerable risk of permanent incapacity. Thus, on an average, 164 days had passed from the time of the accident to the time when full-time work could be resumed or the injury be regulated with an annuity. Permanent annuities averaging 21 % have been issued to those treated.

With a view to elucidating the causes of the widely varying functional results after osteosynthesis a very thorough re-examination has been undertaken of all the survivors (21) of a material of patients from the St. Göran Hospital in Stockholm, comprising 23 operatively treated cases. In addition, the investigation rests upon personal observations made on material from other hospitals.

It is evident that those cases in which the treatment led to functionally very good results had the posterior articular surface of their patellae exactly replaced. Cases in which replacement had been less exact gave considerably inferior late results. It was only in fractures which were located at the apex of the patella, at the outermost edge of the articular surface, or outside the latter, that reduction played a minor part. The postoperative appearance of the femoro-patellar joint was, thus, of the greatest importance.

Operative treatment must therefore aim to the same extent at both *restoration of the torn extensor mechanism and restoration of the articular surface of the patella*. The latter task, often difficult, is not sufficiently heeded in most current surgical treatises.

The fragments of the patella are returned most surely and simply to their right position by supporting and controlling the replacement with a finger introduced under the patella through a medial arthrotomy.

3 cases operated on in this way show practically exact replacement.

Irritant approximation material, such as aluminium-bronze wire, gives rise to changes in the osseous structure of the patella, excrescences, and even free bodies. Wires of this material often break into several parts, and these may cause trouble and even

wander into the joint. Non-irritant fixation material (e. g. catgut, silk, stainless steel wire) ought therefore to be used.

Extirpation of the patella has given such unfavourable results in some observed cases that it seems desirable to await completer investigations, especially as regards the restoration of full power of extension in the knee-joint, before the method is adopted as a general primary method of treatment in fractured patella.

Zusammenfassung.

Eine Untersuchung des Materials der Reichsversicherungsanstalt an operierten Patellarfrakturen aus den Jahren 1918—1923 (44 Fälle) zeigt, wie auch schon frühere, ähnliche Untersuchungen, dass der Nachverlauf nach solchen Frakturen ein langwieriger ist, und dass eine bedeutende Gefahr dauernder Invalidität vorliegt. So waren nach dem Unfall durchschnittlich 164 Tage verflossen, bis der Verletzte seine Arbeit wieder in vollem Ausmasse aufnehmen konnte, oder bis ihm wegen der Verletzung eine Leibrente zugesprochen wurde. Eine definitive Leibrente, und zwar durchschnittlich 21 %, ist einem Viertel der Behandelten ausgezahlt worden.

Um die Ursachen der so stark wechselnden funktioneller Ergebnisse nach Osteosynthese klarzulegen, wurde an sämtlichen Überlebenden (21) eines 23 operierte Fälle umfassenden Patientenmaterials aus dem St. Görkrankenhause in Stockholm eine äusserst eingehende Untersuchung vorgenommen. Ausserdem fusst die Untersuchung auf Beobachtungen des Autors in anderen Krankenhäusern.

Es ergibt sich, dass in den Fällen, wo die Behandlung zu funktionell sehr guten Ergebnissen führte, die Hinterfläche der Patelle exakt reponiert worden war. Die Fälle mit weniger exakter Reposition gaben bedeutend schlechtere Spätresultate. Nur bei Frakturen, die an der Spitze der Kniescheibe, am äussersten Rande der Gelenkfläche oder ausserhalb derselben sassen, spielte die Reposition eine geringere Rolle. Der postoperative Zustand des Femoropatellargelenkes erwies sich also als höchst bedeutungsvoll.

Der operative Eingriff muss also in gleichem Masse sowohl die Wiederherstellung des zerrissenen Streckapparates als auch die Wiederherstellung der Gelenkfläche der Kniescheibe anstreben. Die letz-

tere, oft schwere Aufgabe findet in der Mehrzahl der gebräuchlichen Bücher der Operationslehre nicht genügend Beachtung.

Die Bruchstücke der Kniescheibe werden am einfachsten und sichersten in die richtige Stellung zurückgebracht, indem man durch eine mediale Arthrotomie einen Finger unter die Patella steckt und mit diesem die Reposition unterstützt und kontrolliert.

Drei in dieser Weise operierte Fälle wiesen praktisch exakte Reposition auf.

Einen Reiz ausübendes Osteosynthesematerial, wie Aluminiumbronzedraht, erzeugt Veränderungen der Knochenstruktur der Kniescheibe, Exkreszenzen oder gar freie Körper. Aus diesem Material hergestellter Draht zerfällt oft in mehrere Stücke, die Beschwerden geben und auch in das Gelenk hineinwandern können. Es ist deshalb reizloses Osteosynthesematerial (z. B. Katgut, Seide, rostfesterer Stahldraht) zu verwenden.

Patellarexstirpation hat in einigen beobachteten Fällen so ungünstige Resultate gegeben, dass vollständigere Untersuchungen, besonders über die Wiederherstellung voller Streckfähigkeit im Kniegelenk, abzuwarten sein dürften, ehe die Methode als allgemeine primäre Behandlungsmethode bei Kniescheibenbrüchen Verwendung finden kann.

Résumé.

Une étude du matériel — appartenant à l'Assurance d'Etat — des fractures rotuliennes opérées de 1918 à 1923 (44 cas) montre, comme le faisaient déjà des recherches antérieures semblables, que les fractures de ce genre sont grevées de suites prolongées et d'un risque considérable d'invalidité permanente. C'est ainsi qu'en moyenne 164 jours se sont écoulés entre l'accident et la reprise complète du travail ou le règlement du sinistre par une rente. Celle-ci, qui ascendait en moyenne à 21 %, a été octroyée à un quart des patients.

Dans l'intention de tirer au clair les causes des différences si fortes qu'on observe dans les résultats fonctionnels obtenus par l'ostéosynthèse, tous les survivants (21) d'un matériel provenant de l'Hôpital St. Göran de Stockholm et comprenant 23 cas opérés ont été réexaminés d'une façon particulièrement approfondie. L'étude se base en outre sur les observations que l'auteur a faites sur des blessés d'autres hôpitaux.

Il en ressort que les cas où le traitement a abouti à des résultats fonctionnels très bons sont ceux chez qui la surface articulaire postérieure de la rotule avait été exactement reconstituée. Les cas où la réduction avait été moins précise ont fourni des résultats considérablement plus mauvais. Ce n'est que dans les fractures de la pointe de la rotule ou de l'extrême bord de la surface articulaire ou encore dans celles qui étaient restées en dehors de cette surface, que la réduction a joué un moindre rôle. L'aspect postopératoire de l'articulation fémoro-patellaire a donc été de la plus grande importance.

L'intervention opératoire doit, par conséquent, viser au même degré à *réparer l'appareil extenseur rompu et à rétablir dans son intégrité la surface articulaire de la rotule*. Cette seconde tâche, souvent difficile, ne reçoit pas une attention suffisante dans la plupart des traités opératoires courants.

Les fragments rotuliens sont ramenés le plus sûrement et simplement en bonne position si l'on introduit un doigt sous la rotule par une arthrotomie interne pour les soutenir et pour contrôler la réduction.

Trois cas opérés selon ce procédé montrent une réduction pratiquement exacte.

Un matériel d'ostéosynthèse irritant comme le fil de bronze-aluminium provoque des altérations de la structure osseuse de la rotule, des excroissances, et même la formation de corps libres. Ces fils-là se désagrègent souvent en plusieurs fragments, qui peuvent causer des douleurs, voire émigrer jusque dans la jointure. Aussi faut-il employer un matériel d'ostéosynthèse non irritant, par ex. du catgut, de la soie, du fil d'acier inoxydable.

L'extirpation de la rotule a donné dans quelques cas observés des résultats si défavorables qu'il semble qu'on doive attendre des recherches plus complètes, spécialement en ce qui regarde la capacité d'extension complète du genou, avant d'utiliser cette méthode comme traitement général et immédiat de la fracture patellaire.

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(For more detailed information reference may be made to the comprehensive review and list of the literature given in A. JÄRVINEN's undermentioned work.)

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From the Pathologic Service of Sabbatsbergs Hospital (Chief: Professor BERGSTRAND) and from the Orthopedics and Surgical Tuberculosis of St. Görans Hospital. Stockholm, Sweden
(Surgeon-in-Chief: Dr. S. ORELL).

»Bone Chip» Grafts in Defects in the Long Bones.

A Study on the Transplantation of Bone Chips from Compact and from Spongy Substance in Defects in the Long Bones and on the Rôle Played by the Periosteum and Endosteum in Bone Grafts from Compact Substance.

By

ARVID HELLSTADIUS.

In the transplantation of bone, the use of a number of chips has in some cases proved to be preferable to a single large bone graft. For example, some surgeons have replaced the single transplant in Albee's operation for tuberculous spondylitis with bone chips. The same applies in certain cases of pseudarthrosis, in plastic operations on the roof of the acetabulum, and in arthroereisis. The larger transplants, of course, have a special mission to fulfill in pseudarthrosis, when it is desired to secure primary fixation of the bone ends with the graft. The main advantage of bone chips is the resultant speedier reconstruction of the grafts. Furthermore, it is usually claimed that bone chips, with their larger surface, lead to more prolific new bone formation than one big graft.

In MATTI'S opinion, the small fragments of bone are more resistant than larger grafts in the event of an infection in the operative field. Even in the presence of severe infections, he generally secured consolidation following the transplantation of bone chips, only a few of the chips being sloughed as sequestra.

Bone chips from both compact and spongy substance have been used. The question has arisen, particularly in the case of pseudarthrosis of the diaphyses of the long bones, as to which is preferable: chips from the spongy substance or chips from the compact substance. MATTIS is a warm supporter of spongy substance in these cases. Another moot point concerns the importance of the periosteum and endosteum in bone grafts from compact substance.

I have conducted a number of animal experiments for the purpose of studying these two questions.

I shall begin with the experiments aimed at a comparison between the formation of new bone following the transplantation of compact bone chips complete with periosteum and endosteum and the transplantation of spongy bone chips in defects in the long bones. About 2 cm. of the inferior part of the diaphysis of the radius on both sides was removed extraperiosteally in four rabbits. This resulted in a defect of the radius, but the support of the ulna prevented displacement of the ends of the radius. The resected piece of one of the radii was split lengthwise into several pieces, which in turn were divided into a number of shorter bits. The latter were then replaced in the defect in one radius, being arranged so as to lie longitudinally. These bone chips thus consisted of compact substance with endosteum and periosteum retained. The defect in the radius on the other side was next filled in with a number of pieces of spongy substance, most of them taken from the inside of the trochanter major. In this way there were equally large bone defects in the inferior part of the radial diaphysis on both sides, one of them filled in with bone chips from compact substance and the other with bone chips from spongy substance. The course of the experiments was followed with roentgenograms taken at regular intervals. When the animals were killed, specimens were taken for histologic examination.

A study of the series of roentgenograms reveals that the first new bone formation to be seen in three of the cases (experiments 1, 2 and 4) appeared on the side on which compact substance was used for the graft. In the fourth case (exp. 3), however, this question could not be decided, since the interval between the roentgenograms during this phase of the new bone formation was too long. This new bone formation appeared periosteally around the cut ends of the radius next to the cut surfaces first in the proximal end and later in the distal end. On the side on which spongy substance was implanted, the new bone did not develop around the cut ends until a longer time had elapsed and then to a lesser degree. The cause to this fact is unknown.

On the roentgenograms the outlines of the transplants gradually became less distinct, and the grafts blended with one another and with the cut ends of the radius. After a time the different bone grafts could no longer be distinguished, having been replaced by a single cohesive mass of bone reaching from one cut end to the

other. According to the roentgenograms, the compact grafts remained visible long after the spongy grafts had become indistinguishable from the rest of the bone tissue. In all the cases a cohesive bridge of bone gradually developed between the two ends of the radius, both on the side with the spongy bone grafts and the side with the compact bone grafts. Both forms of graft, therefore, served their purpose, since extraperiosteal resections of radial diaphyses as performed in these experiments do not heal spontaneously (experiment 5).

But, while the bridging of the defect with bone ran a smooth and uneventful course in all the cases in which compact substance grafts were used, in three of the cases (experiments 1, 2 and 4) defective calcification next to the distal end of the radius could be observed during one stage of the development of bone on the side on which spongy substance was used. In two of them (experiments 1 and 2), a defect in the bone shadow next to the distal end of the radius remained long after the two radial ends had been joined by bone on the side on which bone chips of compact substance had been used. The third case (experiment 4) for a long time showed a broad defect which encroached from the radial side deep into the bone shadow next to the distal end of the radius, so that the bridge of bone was noticeably narrower at this point.

The bridge of bone which unites the two cut ends with each other thus showed a smooth external contour on the sides on which compact substance was grafted, while in most cases (experiments 1, 3 and 4) the radial outline on the side with spongy grafts was jagged and uneven, sometimes showing occasional deepish indentations by periosteal soft parts in the bone mass, which irregularities sometimes became filled in later on (experiments 3 and 4).

Medullary space and cortex gradually develop in the new bone between the two cut ends, which at first appears roentgenologically as a homogeneous, undifferentiated mass of bone tissue, and eventually there may be complete restitution of the long bone, not only on the side on which compact bone chips were used, but also on the side on which spongy substance was implanted. MATTI, was able to show that spongy bone matter implanted in a defect in a long bone is transformed into bone with medullary space and cortex.

In experiment 3 the roentgenograms made it appear that differentiation of medullary space and cortex occurred in the same space of time and to the same degree on both sides. Histologic

examination, however, revealed that differentiation was more complete on the side on which compact bone had been used.

In experiment 2 the roentgenograms showed a development of medullary space and cortex on both sides, but more complete on the side on which compact bone chips were used than on which spongy substance was implanted; this was verified by the histologic examination. In experiment 4 differentiation of medullary space and cortex was only seen on the roentgenograms of the side on which compact bone chips had been implanted; the histologic examination, however, showed partial development of medulla and cortex on the spongy side also, although less advanced than on the compact side. When the animal in experiment 1 was killed, practically no roentgenologic signs of medullary space or cortex could be seen on either side; histologic examination, however, revealed relatively advanced differentiation of cortex and medullary space on the compact side, but none on the spongy side. Reorganization of the bone with differentiation of medullary space and cortex thus was slower and less complete where spongy substance had been implanted than where compact tissue had been used for grafting.

Further, it appears from the histologic examination in all the cases in which compact substance grafts were used that the space between the cut ends was completely separated from surrounding soft tissues by newly formed cortex; this was not observed in two cases on the side on which spongy substance had been implanted. In experiments 1 and 3, fibrous tissue from the neighbouring tissue had grown into the space between the cut ends on the spongy side. In one of these two cases (experiment 1) new bone was only found on the ulnar side, forming a bridge from one end of the radius to the other, while on the radial side there were a number of spongy substance chips separated from one another by intruding fibrous tissue. In the other case (experiment 3), in which restitution of the long bone had proceeded further, there were two or three deep, narrow indentations of fibrous tissue from the outside. However, the fibrous tissue was bounded off by newly formed bone, so that the medullary space came to be divided into separate sections. Thus, on the side on which spongy substance had been implanted the surrounding soft tissue showed a certain tendency to grow in between the various bone chips; as mentioned above, this could also be seen on the roentgenograms.

MARRI claimed that the bone cells in the spongy bone graft-

survive, but that those in the compact grafts do not. Wherever spongy bone graft remains were found in my histologic slides, however, there were also empty bone lacunae or bone lacunae with only faintly stained nuclear rests, and the bone cells had disappeared in the spongy bone grafts just as much as in the compact grafts. On the surface of some of the compact and spongy grafts could be seen varying degrees of new bone formation; other grafts, however, showed no trace of new bone.

The formation of new bone in cases with this type of graft originates partly from the soft parts next to the cut surfaces on the radius (and occasionally, at least, to some extent also from the adjacent ulnar surface) and partly from the soft tissue which surrounds the bone grafts. These two sources of new-bone formation together contribute to the evolution of the bone mass which gradually fills the space between the cut ends.

As appears from the roentgenograms, the formation of new bone around the cut ends was more profuse when grafts from compact substance were used than when spongy substance was implanted.

The question may be asked whether there is any difference between compact and spongy bone grafts with regard to their capacity to stimulate surrounding tissue to form new bone. My experiments described above provide no answer to this question, since the newly formed bone in the defect also might have resulted from the growth of bone tissue from the cut ends. Grafting in a »non-bony environment» was therefore indicated. Consequently I proceeded to supplement my experiments by making free grafts of spongy and of compact substance in the gluteal muscles (experiment 6), removing them three weeks later, together with surrounding soft tissue, for histologic study. Fairly plentiful new bone was found in several places on the surface of the compact bone grafts, both on the endosteal side and the periosteal side; in other areas it was scanty, and large areas displayed no new bone whatever. New bone was also seen in some of the Haversian canals. Plentiful new bone was found in two or three places on the surface of the spongy grafts, other areas showed sparse new bone, and large areas showed none at all. There was little or no new bone in the closed medullary spaces in the spongy grafts. Comparison of the two types of graft did not reveal more abundant new bone in the one or the other. The great majority of bone lacunae in both the compact and the spongy grafts were either empty or contained only faintly stained cellular rests.

The formation of new bone around the ends of the radius is important to the fusion of the grafts with the cut ends of the radius. After the transplantation of spongy bone chips, the development of the bone shadow immediately proximal to the distal end of the radius was retarded in three instances; here the relatively scanty formation of bone around the ends of the radius following the implantation of spongy bone substance undoubtedly played an important part.

In the grafting of bone chips, therefore, an intimate contact between the spongy substance and the diaphyseal ends is essential. And this contact is secured with MARRI's operative technique for pseudarthrosis. According to this method, a wide gutter is chiselled out in the cortex next to the pseudarthrosis into the medulla, which is also scraped out. This produces a large graft bed, into which the spongy transplants are packed. But, as appears from my experiments, the surrounding soft parts have a certain tendency to grow in between the different spongy grafts. The larger the spaces between the spongy bone grafts are and the longer the distance to be bridged by the graft, the more the soft tissue can grow intrusively in this way. It appears from the above that the risks in transplanting bone chips are less with compact than with spongy substance, and that the former type is therefore preferable *to the latter*. In additional advantage of bone chips from compact substance is obviously the more rapid reorganization into long bone with differentiation of medullary space and cortex.

The question of the part played by the periosteum on the grafts is also important in the case of transplants of bone chips from the cortex. Should one aim at taking only the superficial, periosteum-covered parts of the cortex, or do grafts free of periosteum serve the purpose equally well? Any number of workers have studied the question of the significance of periosteum and endosteum in the formation of new bone.

LEVANDER injected alcoholic extract of bone tissue into muscle and secured the formation of free bone there in 23 percent of the cases. These results were verified by ANNERSTEN. Thus the formation of new bone free in the soft parts with no connection with bone tissue can be secured by means of injections of bone extract containing no living cells. In these experiments, the periosteal and endosteal cells, like all other living tissue, are eliminated. LEVANDER considered that the formation of new bone occurs as follows: some element in the hard bone tissue is released, becomes diffused

in the surroundings, and stimulates the neighboring mesenchymal cells to form new bone. Hence, he concluded that periosteum and endosteum on grafts are of no importance in the growth of new bone.

It has also been proved that new bone is formed even around bone grafts in which all cells have been killed. For example, WURM implanted burned bone in the abdominal muscles of rabbits, securing new bone growth after three months in some of the cases. ORELL and ENGSTRÖM observed new bone after more than three months had passed since the subcutaneous implantation of boiled bone and four months after the implantation of os purum (bone which has been freed chemically from all organic tissue). They also implanted in soft parts bone in which all the cells had been killed by deep freezing in liquid air, and were able to observe new bone formation thirty days later. In these cases, therefore, no living cells were transmitted with the grafts; the surrounding mesenchymal tissue alone was responsible for the formation of the new bone.

It has also been established that transplants devoid of living periosteum and endosteum can give rise to new bone. However, it takes a much longer time for the new bone to start forming, at least around boiled implants and os purum. For grafts equipped with living periosteum and endosteum show new bone after only six days have passed in the rabbit (JOSSELYN DE JONG and EYKMAN VAN DER KEMP) and after 15 days in man (ORELL and ENGSTRÖM).

Several workers have tried to solve the question of the part played by periosteum and endosteum by transplanting bone from which the periosteum and endosteum have been scraped off. LEXER, BROOKE, and others, implanted this type of graft in soft parts, and found that no new bone grew around the transplants; hence they concluded that the periosteum and endosteum were of decisive importance to the formation of new bone. BASCHKIRZEW and NEMILOW, on the other hand, observed new bone even around grafts from which they had scraped off the periosteum and endosteum. The latter workers claimed, therefore, that the periosteum and endosteum played no part in the formation of new bone. MAYER and WEHNER showed how difficult it is to remove all traces of periosteum by scraping. They concluded that the cases in which new bone was formed from grafts denuded of periosteum were to be explained by the fact that the periosteum had not been

completely removed from the graft. In a few experiments BULL implanted bone with periosteum in a defect in the radius and in other experiments bone from which the periosteum had been removed. He was unable to find on histologic examination any real difference between the two series of experiments. However, the periosteal new-bone formation covering the graft was somewhat poorer in the latter series than in the former, in that the new bone on the surface of the grafts with no periosteum formed a less cohesive layer than on those with periosteum. Substitution of the grafts with no periosteum perhaps occurred somewhat more slowly than of those with periosteum.

I conducted a few experiments with grafts of bone chips both with periosteum and without, in order to compare results. The grafts were implanted both in "bony environment" and in soft parts.

In three experiments (Nos. 7, 8 and 9), a one- to two-centimeter long piece of the diaphysis of the radius was removed extraperiosteally on both sides. The periosteum and superficial portion of the cortex were scraped off the bone removed from one side, after which the piece of bone was split lengthwise and carefully relieved of endosteum. The piece of bone thus freed of periosteum and endosteum was then divided into several smaller pieces, which were replaced in the defect in the radius on one side. The grafts were arranged so as to lie longitudinally in the defect. The same process was repeated with the bone removed from the other side, except that it was not freed from periosteum and endosteum. Thus on one side the defect in the radius was filled with bone chips denuded of periosteum and endosteum and on the other side with grafts with both periosteum and endosteum intact. The subsequent course was followed with roentgenograms taken at fixed intervals.

In all three cases the defect in the radius was filled in with new bone, which extended from one cut end to the other, both on the side in which bone chips with periosteum and endosteum had been implanted and on the side in which bone chips freed of periosteum and endosteum had been implanted. In one case (No. 7) the side on which bone chips freed of periosteum and endosteum had been implanted for a time showed a rarefied zone in the bone shadow next to the proximal cut end, which, however, was later bridged over with bone. Otherwise the formation of new bone occurred about equally rapidly and completely on both sides. In

experiment 8, on the other hand, the new-bone formation on the side on which bone chips freed of periosteum and endosteum had been implanted was definitely slower than on the other side, and when the bridge of bone grew between the two cut ends it was found to be narrow and to pass along the neighboring surface of the ulna. Between the cut ends and apart from the bridge of bone, there were a number of bone grafts, which apparently did not participate in the formation of new bone, and even at a later stage when medullary space and cortex began to be differentiated, these pieces of bone still lay in the soft parts right next to the newly formed cortex. In the third case (experiment 9), the formation of new bone in the defect occurred later on the side with bone chips freed from periosteum and endosteum than on the other side. On the side with transplants equipped with endosteum and periosteum, there was rapid restitution of the long bone with differentiation of cortex and medullary space, while on the other side the cut ends were united by a fairly narrow bridge of undifferentiated bone tissue.

Thus, on the side on which grafts freed from endosteum and periosteum were used, the new bone formation in the defect was slowed up and the differentiation of bone tissue in medullary space and cortex was delayed and incomplete in two of the cases (experiments 8 and 9), while the difference between the two sides was less marked in the third case.

In two other experiments (Nos. 10 and 11), pieces of cortex both with and without periosteum and endosteum were implanted free in muscle. The grafts were removed 20 days later for histologic examination. In one of these experiments (No. 11), the cortical grafts equipped with periosteum and endosteum exhibited plentiful new bone, both on the periosteal and the endosteal side, while the cortical grafts free from periosteum and endosteum lacked any sign of new-bone formation. In the other experiment (No. 10) no new bone had formed on the graft freed from periosteum and endosteum, except in one place on the endosteal side of the graft. The formation of new bone was more extensive along the graft with periosteum and endosteum retained, but less abundant than on the corresponding grafts in experiment 11.

From these experiments with grafts implanted both in a "bony environment" and in soft parts, it would appear that periosteum and endosteum on grafts promote new bone formation, even if they do not play the decisive rôle attributed to them by LEXER,

and that grafts equipped with periosteum or endosteum, or both, are consequently preferable to those from which periosteum and endosteum have been removed.

Summary.

In a number of animal experiments, bone chips from compact substance with endosteum and periosteum retained were implanted in an artificial defect in one radial diaphysis, and bone chips from spongy substance were implanted in a corresponding defect in the other radial diaphysis. The formation of new bone occurred more slowly and less plentifully, and the differentiation of medullary space and cortex took a longer time on the side on which spongy substance was implanted than on the side on which compact substance was used. Occasionally the periosseous soft parts showed a certain tendency to grow in between the various spongy bone transplants.

MATTI's opinion that the bone cells in the spongy grafts survive whereas those in the compact grafts do not, could not be verified. Consequently, bone chips from compact bone would appear to be preferable to bone chips from spongy bone in grafts in defects in the long bones.

Similar grafting experiments in defects in the radius were also done with portions of cortex freed from periosteum and endosteum and with transplants allowed to retain periosteum and endosteum. Grafts of this kind were also implanted in soft parts and later examined histologically. The experiments indicate that periosteum and endosteum on grafts promote the formation of new bone.

Zusammenfassung.

In tierexperimentellen Versuchen wurden periost- und endost-versehende »bone chips« aus kompaktem Knochen in einen Resektionsdefekt der einen Radiusdiaphyse und »bone chips« aus spongiösem Knochen in einen ebenso grossen Resektionsdefekt der anderen Radiusdiaphyse transplantiert. Wo spongiöser Knochen verpflanzt worden war, war die Knochenneubildung langsamer und spärlicher und die Differenzierung in Markhöhle und Kortex fand langsamer statt, als bei Verwendung von kompaktem

Knochen als Transplantationsmaterial. Manchmal zeigten die periostösen Weichteile eine gewisse Neigung, zwischen die verschiedenen spongiösen Knochentransplantate hineinzuwachsen. Die Ansicht MATTI's, dass die Knochenzellen in den spongiösen Transplantaten, zum Unterschied von denen in den kompakten, am Leben bleiben sollten, konnte nicht bestätigt werden. Bei Transplantation in Röhrenknochendefekte verdienen also »bone chips« aus kompaktem Knochen den Vorzug vor »bone chips« aus spongiösem Knochen.

Ähnliche Transplantationsversuche in Resektionsdefekte des Radius wurden ferner mit von Periost und Endost befreiten Kortikalisstücken sowie mit periost- und endostversehenen Transplantaten angestellt. Derartige Transplantate wurden auch in Weichteile eingepflanzt, worauf sie histologisch untersucht wurden. Die Versuche ergaben, dass das Periost und Endost an den Transplantaten die Knochenneubildung fördert.

Résumé.

Dans un certain nombre d'expériences sur des animaux des «copeaux osseux», munis de périoste et d'endoste, et pris sur de l'os compact, furent greffés dans une perte de substance de l'une des diaphyses radiales, et des «copeaux osseux», prélevés sur l'os spongieux, le furent dans une perte de substance de même grandeur au niveau de l'autre diaphyse radiale. Là où fut transplantée de la spongieuse la formation d'os nouveau fut plus lente et moins abondante, et la différenciation de la cavité médullaire et de la corticale se produisit moins rapidement que du côté où l'os compact avait été employé comme matériel de transplantation. Parfois les parties molles périosteuses avaient une certaine tendance à pousser des prolongements entre les divers greffons spongieux. L'opinion de MATTI selon laquelle les cellules osseuses des greffons spongieux survivraient par opposition à celles des greffons compacts n'a pas pu être confirmée. Aussi faut-il, lors de transplantations dans des pertes de substance d'os cylindriques, préférer les «copeaux osseux» provenant d'un os compact à ceux pris sur un os spongieux.

De plus, l'auteur a fait des essais semblables de greffage dans des pertes de substance par résection du radius, en prenant des morceaux de corticale sans périoste ni endoste, et d'autres avec

des greffons pourvus de périoste et d'endoste. Des greffons de ce genre furent même transplantés dans les parties molles, après quoi on les soumit à un examen histologique. Les expériences montrèrent que la présence de périoste et d'endoste au niveau des greffons accélère la néoformation d'os.

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From the Surgical Service of the Central Hospital of Västerås.
(Surgeon in-chief: Dr. ERNST BERGENFELDT.)

On the Surgical Treatment of Acute Hepatitis (So-called Catarrhal Icterus).

By

ERNST BERGENFELDT.

According to the present conception of the genesis of acute hepatitis, formerly called catarrhal icterus, surgical intervention is not indicated on the whole. Nevertheless it happens now and then that exploratory laparotomy is suggested in cases of long-standing, severe icterus, concluded to be of hepatic origin by the internist, usually because of doubts as to the correctness of the diagnosis. Five cases of this kind were referred to the surgical service of the Västerås Hospital during an epidemic of hepatitis the second half of 1942 and the first half of 1943. In the first case, which had advanced lesions in the liver, only exploratory laparotomy was done and the patient died later from hepatic insufficiency. In the other four cases more active surgical measures were used, consisting of perfusion of the biliary passages, with the contrast matter for cholangiography in three cases and with physiologic salt solution as well in the fourth. Marked improvement occurred after the operation in these cases and the patient made a rapid recovery. A report of these cases should therefore be of interest. In order to be able to discuss what was effected by the surgical intervention, however, it is necessary first to take up the question of the pathologic processes which are supposed to lie behind the disease.

The theory at the basis of the old conception of the pathogenesis of catarrhal icterus was presented by VIRCHOW in 1865. According to it, the primary cause was gastroduodenitis which

encroached upon the most inferior part of the common bile duct and caused catarrh in the portio duodenalis choledochi. The jaundice was believed to be caused purely mechanically by occlusion in this part of the duct, due partly to the swollen mucosa and partly to an obstructing plug of tough mucus and necrotic epithelial masses. When it was objected that a sound could be passed through the duct on autopsy of these cases and that by pressure on the gall bladder, bile could be made to empty into the duodenum, VIRCHOW replied: "Man übersieht, dass katarrhalische Zustände der Schleimhäute, genau ebenso wie erythematöse und erysipelatöse der äusseren Haut, mit dem Tode Veränderungen eingehen, durch welche das Verhalten derselben Theile während des Lebens zuweilen fast ganz unkenntlich wird . . . Ich behaupte also, dass in diesem Falle der cadaveröse Zustand überhaupt keinen bestimmten Massstab für den vitalen abgibt."

According to EFFINGER, only a few of the leading scientists of the day agreed with VIRCHOW but VIRCHOW had such great authority that most of them made no opposition in writing. The many theories later formulated to explain this form of icterus show the scepticism with which VIRCHOW's theory was regarded. The other theories developed in two different directions. One began with MINKOWSKI (1892) who believed that the jaundice was due to a functional disorder in the liver cells. According to him, the accumulation of bile in the blood pathways and tissues was due to its being secreted in the wrong direction, a process which he called parapedesis (1904). (A similar theory had already been presented in 1890 by the Danish physician FLINDT, but it was overlooked). The other type of theory began with NAUNYN (1911) who placed main stress on infection of the biliary ducts, *cholangie*. NAUNYN's pupil, UMBER, developed the theory further. They maintained that *cholangie* was a purely clinical concept, not necessarily based on morphologically demonstrable processes, but that it could develop into real cholangitis. Cholangie need not give rise to jaundice, they stated, until it encroached upon the parenchyma of the liver. UMBER said in 1932: "Dieser cholangiogene Ikterus ist meiner Überzeugung nach ein hepatocellulärer Ikterus, nicht etwa ein Stauungsikterus durch mechanische Erschwerung des Gallenabflusses in entzündlich geschwollene Cholangien, wie man früher annahm. Ein hepatocellulärer Ikterus kann sich selbverständlich auch ohne vorangegangenen cholangischen Infekt entwickeln, im Sinne MINKOWSKIS". Thus both

theories agree that the jaundice is purely hepatogenic and not due to mechanical obstruction in the biliary passages. They differ as regards the point of attack of the disease agent.

However, VIRCHOW's theory was the one given in the textbooks and handbooks far into our present day. The real change in general opinion came first when EPPINGER (1918) presented anatomic proof of the presence of marked parenchymatous changes in the liver even at an early stage of catarrhal icterus. During the former world war, EPPINGER examined the livers of four soldiers killed in battle shortly after they fell ill of the disease. In all four cases the liver had a normal gross appearance but on microscopic examination EPPINGER observed diffusely disseminated foci of destruction in the parenchyma with necroses, mainly situated in the center of the liver acini. No signs of obstruction or any other change could be seen in lumina of the external biliary ducts. Similar changes in the liver have since been observed by several authors. K. ROHLM and P. IVERSEN in Denmark confirmed EPPINGER's observations by so-called aspiration biopsies in patients suffering from catarrhal icterus. Although pathologic studies of this disease are naturally very few, they, together with the results of the modern Tests of liver function, have led to catarrhal icterus now being generally considered as acute hepatitis, or hepatosis. In Sweden F. LINDSTEDT claims that it is a specific infectious disease with an incubation period usually between two and four weeks, and also that the epidemic and sporadic cases are different forms of the same disease, and A. WALLGREN has presented evidence which indicates that the infecting medium is an ultramicroscopical virus. EPPINGER still (1940) believes that the liver changes are due to intoxication, usually of alimentary origin.

The modern theory of the purely hepatogenic pathogenesis of catarrhal icterus has not been accepted everywhere. Thus in 1934 A. F. HURST and C. K. SIMPSON maintained that two different diseases were concealed behind the term catarrhal icterus: 1) real catarrhal icterus, the commonest form in England; the jaundice is then of the obstructive type, caused by duodenitis encroaching upon the common duct, the impediment being the swollen duodenal mucosa, the swollen mucosa in the orifice of the common bile duct, a plug of mucus and epithelial masses, or a cramp in Oddi's sphincter, due to the inflammation; 2) a mild form of subacute hepatic necrosis.

EPPINGER (1937) divides catarrhal icterus into three different pathologic forms: 1) Parenchymatous icterus with destruction and necrosis of the liver parenchyma, mainly in the center of the acini. These lesions cause the liver cells to lose contact with one another, with the result that the biliary capillaries are burst apart and the bile is emptied out in the perivascular lymph spaces and passes from there into the blood. This is the commonest form. 2) The periacinous or cholangitic form, mainly marked by chronic inflammatory infiltration with cellular agglomerations alongside the finest biliary passages (connection with Naunyn's and Umber's cholangie). 3) Icterus caused by swelling at Vater's papilla. According to EPPINGER the second form is uncommon and the third form extremely rare and hardly to be reckoned with, only three cases being described in the literature. EPPINGER (1908) himself described one of the cases, where the mucous membrane in the orifice of the common duct was greatly thickened by inflamed and swollen adenoid tissue, and the lumen completely occluded by detritus, leukocytes and detached epithelial cells, it being almost impossible to pass a sound down into the duodenum from the dilated biliary ducts (a condition virtually identical with Virchow's "mucus plug"). The second case was described by G. TOELG and E. NEUSSER (1884) and the third by E. RYSKA (1902). To these, however, HURST and SIMPSON added three more cases, two of WILLCOX (1915) with marked duodenitis and swelling of the mucosa in the common duct and one of ROLLESTON (1915) with duodenitis and a mucus plug in the orifice of the duct. In addition, several authors, when making autopsies, have observed numerous, greatly enlarged lymph glands in the porta hepatis which could have produced stenosis of the biliary ducts. Thus A. WALLGREN made this observation in three cases from the great jaundice epidemic in Gothenburg in 1925.

Finally a few words will be given to K. WESTPHAL's dyskinetic theory. WESTPHAL showed experimentally with rabbits that weak stimulation of the vagus nerve caused the gallbladder to contract, the bile then emptying into the intestine. Stronger stimulation of the nerve caused more violent contractions of the bladder but also a cramp in Oddi's sphincter which prevented the bile from emptying, — hypertonic biliary stasis developed. Stimulation of sympathetic fibers (electrical or through injections of epinephrine) caused atonic biliary stasis (lowering of pressure in

the gallbladder, with dilation of the bladder and common duct and simultaneous cessation of outflow). According to WESTPHAL, hypertonic dyskinesia, in particular, could cause marked symptoms with typical gallstone colic and sometimes icterus.

It is obvious from the foregoing survey that the pathogenesis is not yet definitely determined. In this connection I should like to quote a statement ISRAEL HOLMGREN made in a discussion in 1933: "Catarrhal icterus is now considered to be a form of hepatitis. For my part I have never felt fully satisfied with this extreme opinion. The old opinion was that catarrhal icterus was an ascending infection, a form of angiocholitis. To my mind, the true state of affairs lies as so often elsewhere midway between the two extremes, thus that catarrhal icterus is characterized by both hepatic and angiocholitic changes."

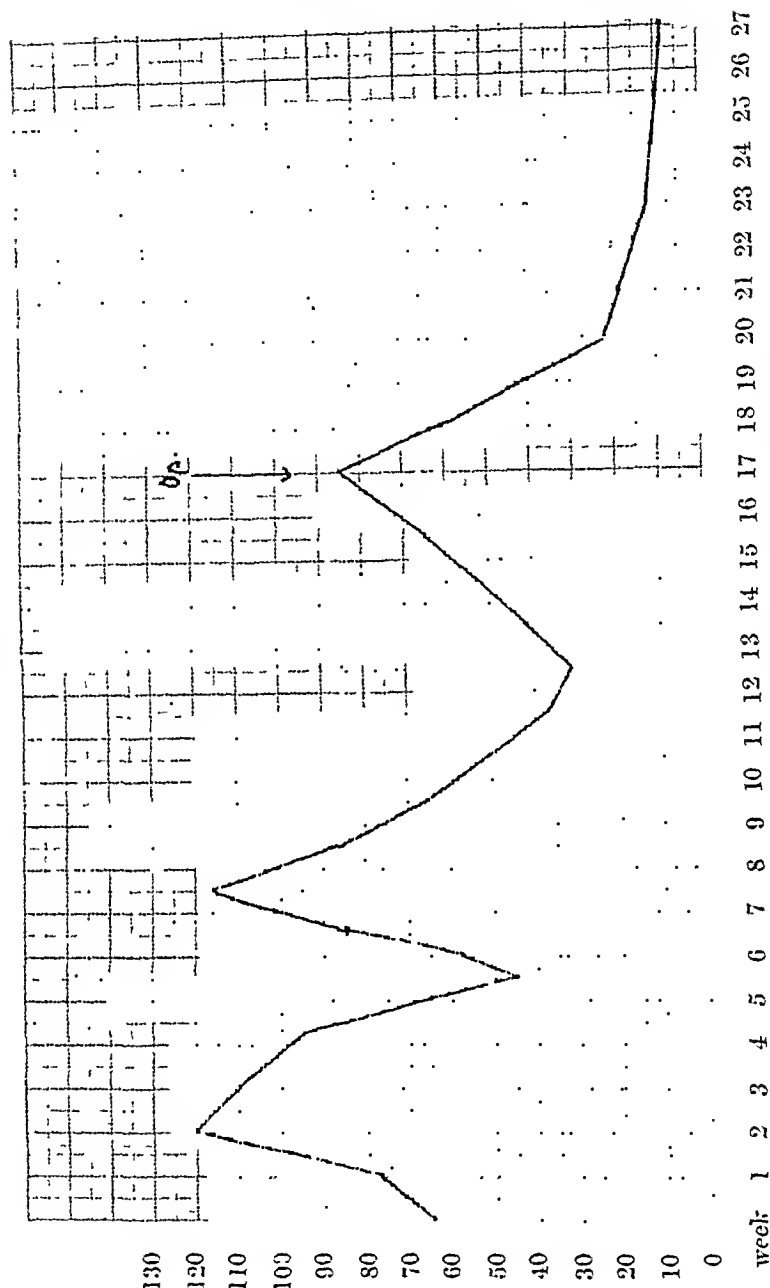
At the end of September 1942, a 52-year-old woman who had suffered for five months from hepatitis with severe icterus was referred from the medical service of the Central Hospital of Västerås to the surgical service. Exploratory laparotomy revealed advanced changes and great enlargement of the liver, which was diffusely and finely nodulated on the surface. The external biliary passages and the pancreas appeared to be normal. As it was evident that it was a question of hepatic cirrhosis and there were no signs of impediment in the biliary ducts, no further measures were taken. The patient died three months later. On autopsy the liver showed the picture of chronic hepatitis.

Shortly after the exploratory laparotomy in this case, another patient was referred to us with practically the same disease history and pathologic changes, except that severe icterus had been present for no less than seven months. In order to confirm the diagnosis cholangiography was performed during the operation; it showed free passage to the duodenum. Because of the severe liver lesions we were pessimistic about the outcome in this case as well, but to our surprise shortly after the operation the jaundice began to disappear rapidly. The bilirubin index (in the blood serum determined according to MEULENGRACHT) sank and was close to normal four weeks later. The patient recovered. Three other cases of hepatitis with long-standing severe icterus were afterwards treated in the same way with the same favorable results. I shall now give a short description of these four cases.

Case Reports.

Case 1. A man, 57 years old, fell ill in March 1942 with icterus which soon became very severe. He was admitted to the medical service on May 2. The bilirubin index was then 161. The Takata reaction was negative (May 4 and 5 June). The stools were clay-colored and reacted negatively to mercuric chloride. The liver was greatly enlarged, reaching three fingerbreadths below the costal margin. As seen from curve 1, the bilirubin index varied considerably during the subsequent course, and sometimes the intestine showed complete acholia and sometimes it contained bile (a common occurrence in hepatitis). The bilirubin index curve showed a distinct fall in two different periods but it was again rising at the time of the operation. The jaundice showing no signs of paling despite long internal treatment and the general condition becoming more and more affected, the patient was transferred on September 29 to the surgical service. On October 7 laparotomy was done. The liver was considerably enlarged, reaching almost to the umbilical plane, markedly icteric and diffusely and finely nodulated on the surface. The gallbladder was fairly large but not distended; on puncture 30 cc. of apparently normal bile were obtained. It was attempted at first to perform cholangiography via the gallbladder according to HULTÉN, but the medium could not be pressed down into the biliary ducts. The common bile duct was then exposed but it did not seem to be dilated. The duct was punctured with a fine syringe needle, whereupon normal-looking bile was obtained, and the contrast medium was injected directly in the duct. The biliary tree filled well and showed normal width; the medium also ran profusely down into the duodenum. There were no signs of concretions. The puncture opening was sutured with fine silk. The pancreas was explored and appeared to be normal. A drainage tube was applied against the common duct and the abdominal wall sutured. The postoperative course was uneventful apart from a moderate secretion of bile the first two weeks. The bilirubin index, which at the time of the operation was 85, dropped during the first postoperative week to 61, during the second to 41, during the third to 22 and during the fourth to 19, at the same time as the jaundice successively receded. The stools were normally colored and reacted positively to mercuric chloride during the whole postoperative course. The Takata reaction and galactose tolerance test were negative one month after the operation. On discharge on November 18, six weeks after operation, the bilirubin index was 12, the jaundice almost gone and the liver edge was palpated two fingerbreadths below the costal margin. Re-examination on December 17 showed a bilirubin index of 9, no icterus and the liver edge one fingerbreadth below the costal margin. On Jan. 18, 1943, the bilirubin index was 4, the liver was scarcely palpable and the patient felt entirely well. On August 4 the index was 5 and there was no demonstrable enlargement of the liver. On November 8 the patient was com-

Curve I.

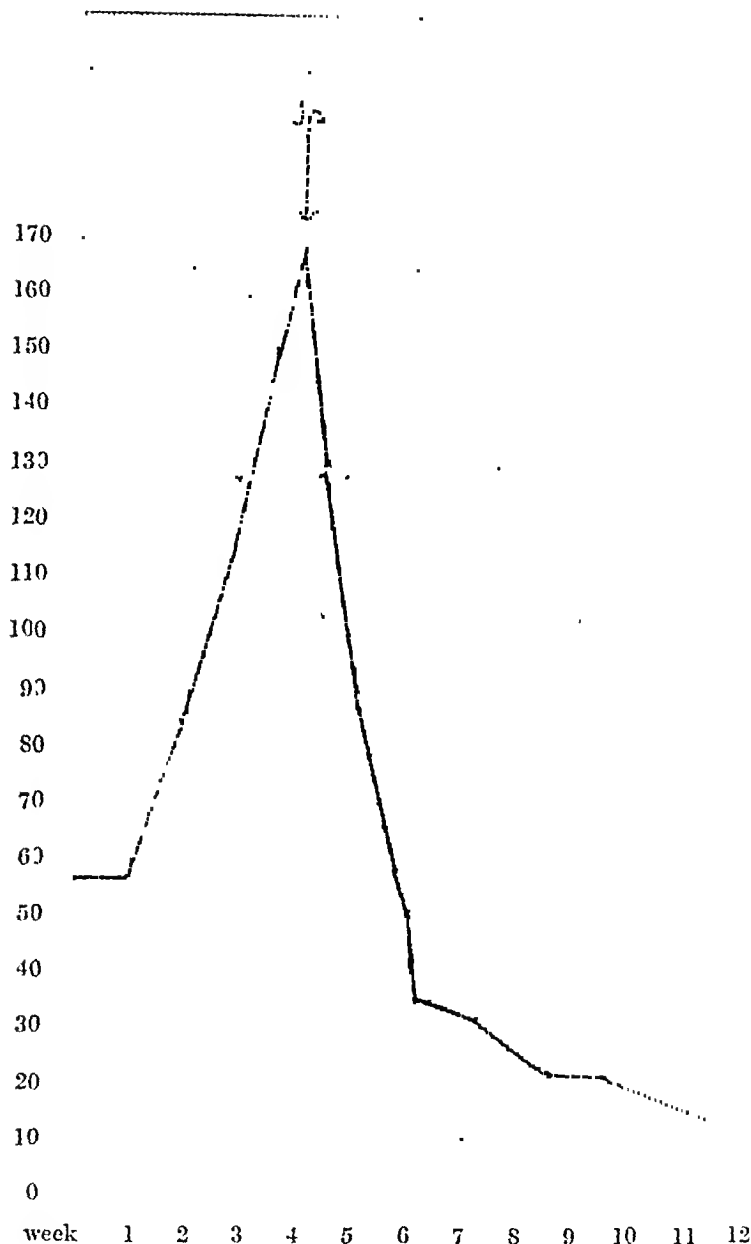


Case I. Bilirubin values before and after operation.

pletely healthy, showing no trace of his former disease, and no enlargement of the liver was noted. He had resumed his former occupation as a building carpenter on March 1 and was fully capable of work.

Case II. A woman, aged 58, had previously suffered from a number of symptoms of indefinite nature in the upper part of her abdomen. Cholecystography on Jan 3, 1942 did not result in visualization of the gallbladder and no calcific shadows were observed. She fell ill in the middle of September with jaundice without pain. She was admitted

Curve II.



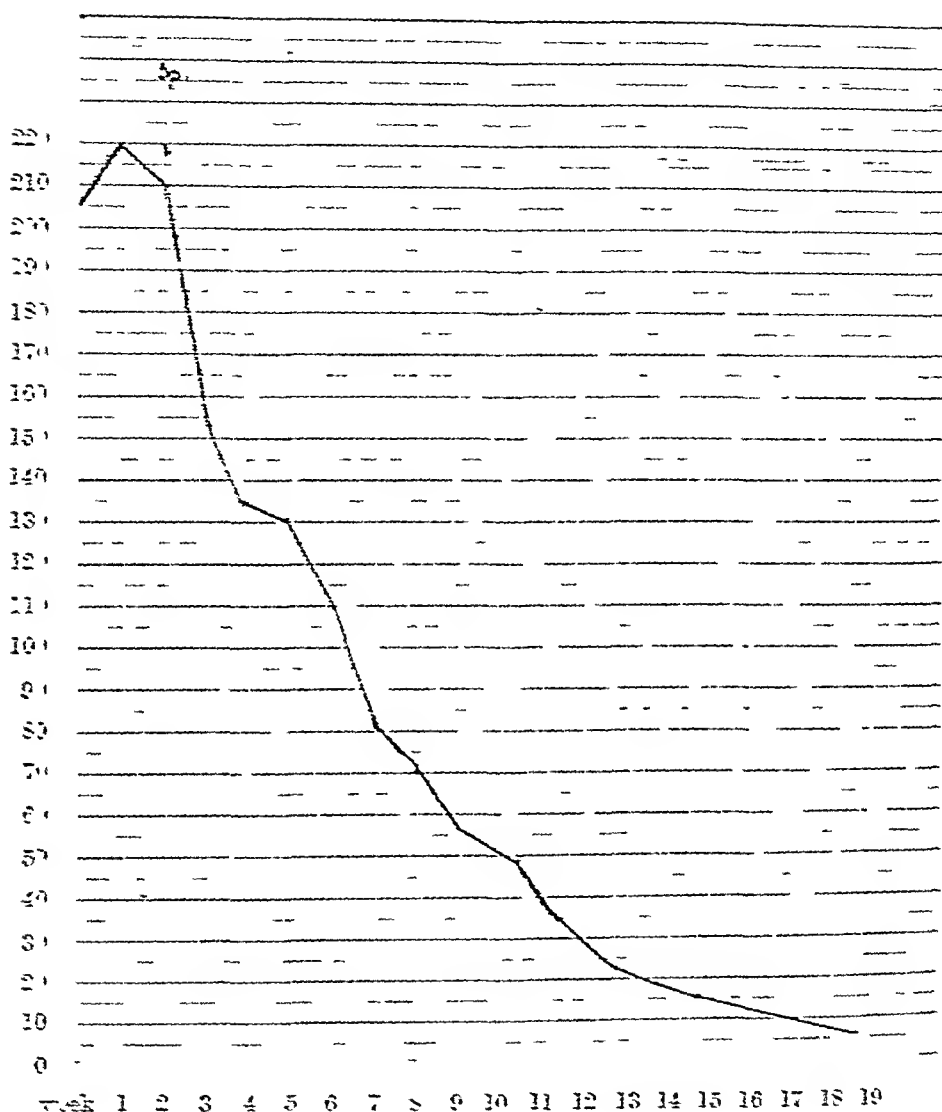
Case II. Bilirubin values before and after operation.

to the medical service on September 22. As the bilirubin index rose rapidly from 57 to over 100 and the patient had earlier had symptoms which could indicate gallstones, she was transferred on October 15 to the surgical service. On October 19 cholecystectomy and cholangio-

graphy were performed. No gross changes were seen in the liver. The gallbladder was shrunken and contained one walnutsized and one hazel nut-sized stone. The cystic duct was of normal width; cholangiography was done from it, showing biliary ducts of normal width, a free passage and no signs of conerements; the contrast medium ran profusely down in the duodenum. On aspiration from the common duct before the cholangiography normal-looking bile was obtained. The pancreas looked normal. The gallbladder was removed. A drainage tube was inserted and the abdominal wall sutured. The postoperative course was uneventful. Microscopic examination of the removed gallbladder showed chronic cholecystitis but no acute changes. Before the operation the stools were colorless and reacted negatively to mercuric chloride; after the operation the conditions were reversed. As seen from curve II, the bilirubin index dropped greatly after the operation, from 180 to 22 in one month. On discharge on December 14, it was 14 and the jaundice was almost gone, disappearing completely soon afterwards. On November 24, one month after operation, the citric acid in the serum was 39.3 and the serum phosphatase 10.3 — hepatic values (Professor LEHMAN). On reexamination on Nov. 9, 1943, the patient was entirely well, there was no jaundice, the bilirubin index was 6 and there was no trace of the former illness.

Case III. A man of 40 fell ill with icterus without pain in the middle of September 1942. He was admitted to the surgical department on November 4, when a bilirubin index of 206 was noted. On November 10 the serum citric acid was 31.6, the serum phosphatase 20.8 and the bilirubin index 220 — pointing to hepatitis (Professor LEHMAN). On November 17 the corresponding values were 29.2, 20 and 210 (Professor LEHMAN). The stools were clay-colored and reacted negatively to mercuric chloride. On November 19, cholangiography, perfusion of the biliary passages with physiologic salt solution and cholecystectomy were done. The liver was large and swollen, reaching a handbreadth below the costal margin, and had a smooth surface. Histologic examination of a biopsy specimen revealed hepatitis. The gallbladder looked normal, was not dilated, showed no stones and contained apparently normal bile. Cholangiography through the cystic duct showed a free passage, biliary ducts of normal width and no signs of stones; the common duct contained bile of normal appearance. The biliary passages were perfused with 100 cc. of physiologic salt solution. The pancreas was normal. The gallbladder was removed after ligation of the cystic duct. A drainage tube was inserted and the abdominal wall sutured. The patient was fairly ill the first day after the operation but the course was otherwise uneventful. The stools were normally colored and reacted positively to mercuric chloride the whole time after the operation. The bilirubin index dropped rapidly at first and then more slowly (curve III). On discharge Feb. 19, 1943, three months after operation, the jaundice had almost gone and the bilirubin index was 16. One month later the jaundice had disappeared and the index was 7. On April 14 there was no demonstrable enlargement of the liver

Case III.

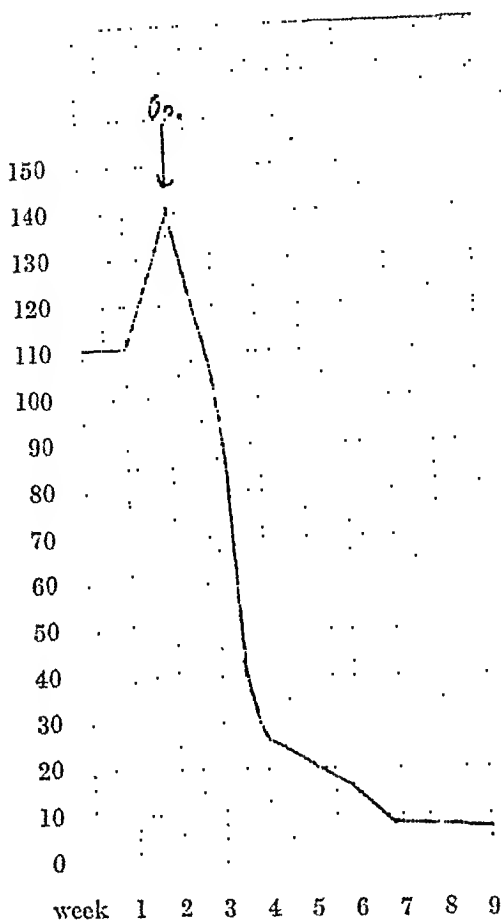


Case III. Bilirubin values before and after operation.

and the index was 8. On July 2 it was 5. On November 10 the patient was completely healthy, the bilirubin index was 5 and the liver was of normal size.

Case IV. A man aged 48 fell ill with icterus without pain in the middle of May 1943. He was admitted to the medical department on May 28, when slight icterus, a bilirubin index of 21, and the liver edge one fingerbreadth below the costal margin were noted. On June

Curve IV.

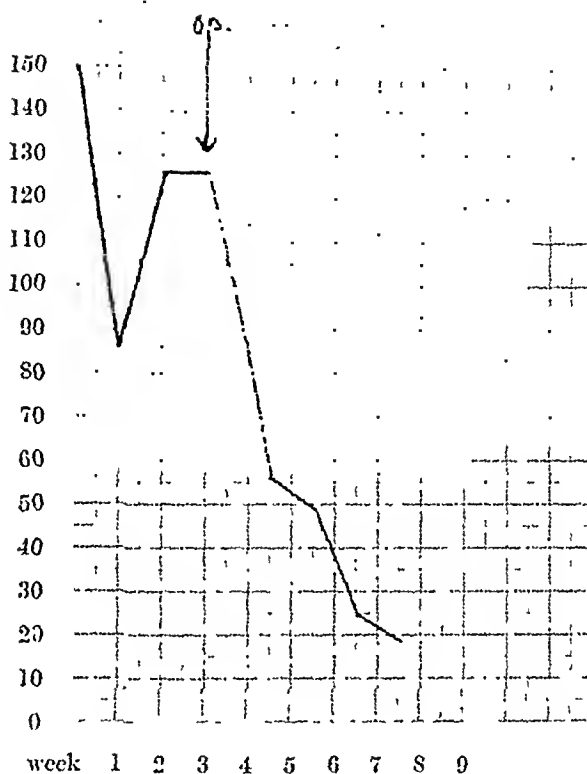


Case IV. Bilirubin values before and after operation.

a) Bilirubin curve in case IV.

10 the icterus was severe, the bilirubin index was 101, the stools were clay-colored and reacted negatively to mercuric chloride. On June 21 the patient was transferred to the surgical service with a bilirubin index of 141 and intense icterus. On June 25 laparotomy and cholangiography were performed. The liver was slightly swollen. The gall-bladder was distinctly dilated but otherwise of normal appearance; it emptied and relaxed after the cholangiography, which was done directly in the common duct. Cholangiography showed free passage, biliary passages of normal width and no signs of concretions. Nor did the gall-bladder show any stones. The common duct contained normal bile. The pancreas was normal. A drainage tube was applied against the common duct and the abdominal wall sutured. Bile was excreted from the wound during the following week, but the course was uncomplicated otherwise. Improvement was rapid and the icterus receded. The bilirubin index (curve IV) was 141 at operation on June 25, 100 on June 27, 96 on June 30, 33 on July 5, 29 on July 10, 17 on July 20,

Curve V.



Case IV. Bilirubin values before and after operation.

b) Bilirubin curve in case of pancreatic cancer treated with cholecysto-gastrostomy.

9 on July 27 and 8 on August 13, when the jaundice had completely disappeared and the patient was discharged. The stools were normally colored and reacted positively to mercuric chloride the whole time after the operation. On examination November 9, the patient was entirely healthy, the bilirubin index was 5 and the liver was not enlarged.

The common feature of all these four cases — and no others were operated upon — was thus severe icterus on a hepatic basis persisting for several weeks or months, without there being any demonstrable impediment in the biliary passages. After the surgical intervention, which consisted of perfusion of the biliary passages, — in 3 cases only in the form of cholangiography, in case III with physiologic salt solution as well — the jaundice

disappeared, rapidly in cases I, II and IV and more slowly in case III. In all the cases the bilirubin index sank greatly immediately after the operation. Case I is particularly noteworthy. There the liver showed such serious lesions that the prognosis was regarded as serious. Nevertheless not only did the jaundice disappear and the patient fully recover, but the enlarged liver returned to normal size. This does not exclude the possibility, however, that cirrhosis of the liver may develop later on. The diagnosis of hepatitis was certain in all the cases, in my opinion. They all occurred during a large epidemic of hepatitis and cholangiography showed free biliary passages in every instance. In case I there were severe changes in the liver, and there is no doubt about the diagnosis. In Case II the gallbladder contained stones, it is true, but the biliary ducts were free, and icterus with bilirubin values up to 180 can hardly be explained under such circumstances other than by the presence of hepatitis. Furthermore study of the serum citric acid and phosphatase one month after operation showed values indicative of hepatitis. In case III microscopic examination of a biopsy specimen from the liver revealed hepatitis. In case IV, no test of the liver function or biopsy was carried out, but the swollen liver and the free biliary passages make the diagnosis of hepatitis fairly certain.

The question of what really was effected by the surgical intervention in these cases is difficult to answer from the standpoint of the present conception of the genesis of the disease. Were VIRCHOW's theory of the "mucus plug" still accepted, the answer should have been easy, i. e. the plug was flushed away, the bile was able to run down into the intestine again and the jaundice was relieved. For that matter a similar therapeutic measure was recommended during the VIRCHOW era, viz. external compression of the gallbladder to press the bile down into the duodenum and thereby get rid of the impediment. As a matter of fact evidence may be presented in favour of the presence of an impediment in the common bile duct. The jaundice in acute hepatitis is sometimes associated with complete acholia of the feces; at other times the bile passes down into the intestine. When the jaundice is mild, the stools are normally colored and react positively to mercuric chloride; when there is acholia the icterus becomes more intensive and the bilirubin index rises. In many cases periods of acholia and severe icterus alternate with ones of colored stools and milder jaundice. The absence of bile

in the intestine has been said to be due, not to obstruction in the biliary passages but to defective formation of bile caused by the hepatitis. If this were true one would expect to find collapsed and empty, or nearly empty, biliary passages on operation, perhaps also changes in the bile itself. In all the cases I operated upon, the common duct contained an apparently ordinary amount of ordinary-looking bile, and in two cases a fairly large amount of bile ran out through the wound in the abdominal wall after operation. The biliary ducts seemed to be of normal width. In case IV there was obviously an *increased* accumulation of bile in the gallbladder, which emptied out through the common duct after cholangiography. Thus no defect in the flow of bile to the biliary passages nor visible change in the character of the fluid was observed. Bile was present in the gallbladder and common duct. Why did it not run down into the intestine? When one sees that after perfusion of the biliary passages, the clay-colored stools return to normal color, the bilirubin index drops and the jaundice recedes to finally disappear, it is hard not to believe that some impediment in the common duct was removed. During the period of time the cases of hepatitis occurred, I also operated upon two cases of pancreatic cancer with complete biliary stasis. In one case cholecysto-gastrostomy was done, in the other choledochoduodenostomy. It took about the same length of time after the operation in these cases as in the ones of hepatitis for the bilirubin index to drop to nearly normal, i. e., about four weeks. It is reasonable to assume, therefore, that analogous effects were produced by the different operations, in other words, that an impediment to the flow of bile was also removed in the cases of hepatitis. Figure V shows how like one another the postoperative bilirubin index curves were in case IV of hepatitis and the case of cholecysto-gastrostomy.

However, cholangiography showed clearly in all four cases of hepatitis that there was no large mechanical impediment in the biliary passages. The contrast medium ran easily down into the duodenum and the biliary ducts were not widened. No doubt the prime reason for the jaundice was hepatitis. But is it not possible that there was a *relative* impediment, an accumulation of tough mucus in the lower part of the common duct and/or cohesion of the mucosal surfaces, sufficient to obstruct the flow of bile, which was under subnormal pressure because of the hepatitis, and that it was removed by the greater pressure caused

by the perfusion? In such a case the hepatitis would be aggravated by the impeded flow of bile, the pressure of the bile be still further reduced and a vicious circle develop which is broken by the perfusion. A relative impediment of this kind need not lead to distension of the biliary ducts, for when the pressure in the bile rises over a certain level, the bile seeps down into the intestine and the pressure is relieved. This hypothesis would also explain the alternating periods of absence and presence of bile in the intestine.

Another theoretical possibility is that there is dyskinesia in the biliary passages, mainly in the form of cramp in Oddi's sphincter due to the hepatitis, and that the cramp is relieved either by the anesthesia or by vegetative nervous impulses excited by the manipulations during the operation. But it is difficult to explain a permanent improvement by this means. Furthermore, after the exploratory laparotomy and external exploration of the biliary passages in the first case described, no decrease was noted in the jaundice, which one might have expected if dyskinesia with cramp in Oddi's sphincter were the essential cause of the severe icterus. The manipulation of the hepatoduodenal ligament needed for careful examination of the common duct should elicit just as many vegetative nervous impulses as cholangiography.

Finally, one cannot entirely exclude the possibility of purely spontaneous improvement, independent of the operation. However, it would be strange if in four successive cases the operation was done at the very moment when the disease had reached its peak and rapid recovery set in, particularly as the jaundice had been present for such different lengths of time before the operation, for five weeks, six weeks, two months and seven months, respectively.

On study of the literature one finds a fairly large number of cases described which confirm the value of operative intervention in this form of icterus. The therapeutic principle in all of them has been to remove strain from the liver by draining off bile, either outwards through the common bile duct or by cholecystostomy, or by internal fistulas. (Cholangiography does not seem to have been done). VON HABERER published 17 cases in 1933, all of which recovered, despite the fact that in some of them the patients were almost moribund, and the operation was used as a last resort. In most of the cases VON HABERER made a gall-bladder fistula. In 1938 NORDMANN published 18 cases treated

with drainage through the common duct, 15 of which recovered. FRANGENHEIM reported 10 successful cases. BACKHAUS operated on 7 patients, 2 of whom died. BACKHAUS treated only his first case by inserting a drain into the common duct; in the others he only made an incision in the wall of the duct and placed a tube against the opening through which the bile could run out. Because of the good results in the latter cases, he concluded that the effect of the operation was not due to the drainage of bile. His theory was that it was caused by stimulation of the vagus and sympathetic fibers running in the hepatoduodenal ligament by the manipulations needed for the exposure of the common bile duct. He said that stimulation of the sympathetic fibers, in analogy with peri-arterial sympathetomy, increased the circulation of blood in the liver, and stimulation of the vagus nerve increased the excretion of bile, both of which processes had a favorable affect on the hepatitis. As VON HABERER pointed out, however, the bile was drained off in these cases of BACKHAUS as well, even if no drainage tube was inserted into the common duct. In addition there are a number of reports concerning one or a few cases. TYGE GERTZ recently published four cases from Copenhagen, only one of which showed a lasting improvement, however. Apart from a few cases in which the operation did not have the desired effect, probably because irreparable lesions had already developed in the liver, the effect of surgical therapy has been so obvious that there is reason for surgeons to adopt a more active standpoint than hitherto in regard to the treatment of the disease, even though we are not able, with our present knowledge of acute hepatitis, to give a fully satisfactory explanation of what is really effected by the operation.

As regards the indications for operation, the cases which should be operated on fall into two groups. To the first group belong the ones in which the diagnosis is uncertain. Despite all the modern tests of liver function it is rather often difficult to say whether the patient suffers from hepatitis or obstructive jaundice, especially at an advanced stage. Hepatitis is sometimes accompanied by pain like that caused by stones in the common bile duct, and some cases of stones in the duct are not characterized by much pain. Cancer in the pancreas or Vater's papilla may produce a clinical picture reminiscent of longstanding hepatic icterus — to mention a few examples. These patients should, of course, be operated on. Cholangiography gives a rapid and reliable pic-

ture of the situation. To the second group belong the sure cases of hepatitis, with severe jaundice not receding after a reasonable length of time. Acute hepatitis is most often a fairly benign disease cured in a few weeks by suitable medical treatment, and *these cases naturally do not belong to the surgeon*. Now and then however, one meets ones with severe and stubborn icterus, persisting for weeks or months, not infrequently ending in acute yellow atrophy or cirrhosis of the liver with hepatic insufficiency. There is reason to believe that with active surgical therapy a number of these patients may be saved. Perhaps, also, the number of cases which after hepatitis are predisposed to chronic hepatic insufficiency later on may be reduced by suitable timed operation. It is naturally not possible to state the exact time the operation should be done. It depends upon the course of the disease and the general condition of the patient. As a general rule it may be said, however, that if severe jaundice with a bilirubin index of 100 or more and with a distinct effect on the general condition has persisted for more than a month to six weeks, without showing any signs of receding despite all internal agents, operation should be considered, especially if there is complete acholia in the intestine.

Which method of operation should then be used? My cases have shown that perfusion of the biliary passages in the form of cholangiography may be sufficient. Cholangiography should be done in any case to certify the diagnosis. If there are changes in the gallbladder — stones, chronic cholecystitis — which indicate its removal, the cholangiography should be done as usual in the cystic duct. If the gallbladder is normal, there are two possibilities to choose from, Hultén's method via the gallbladder, or if this method is unfeasible, as in my case I, puncture with a fine syringe needle and direct injection in the common duct can be done. The latter method is just as good as ordinary cholangiography. One has to reckon with a short period of excretion of the bile outwards, but perhaps this is only an advantage, owing to the strain it removes from the liver. If cholangiography does not give the desired result, there is always the possibility of making an external biliary fistula afterwards. In the cases where there is an impending danger of collapse of the liver function, cholecystostomy should be done or drainage effected from the common duct from the beginning.

Summary.

The author describes four cases of acute hepatitis with severe jaundice not relieved by internal therapy. The jaundice, which had persisted for 7 months, 2 months, 6 weeks and 5 weeks, respectively, disappeared rapidly after operation in all four cases and the patients recovered. The surgical treatment consisted of perfusion of the biliary passages with the contrast matter for cholangiography, in one case with physiologic salt solution as well. The author presents the following hypothesis to explain the effect of the operation: The cholangiography showed that there was no large impediment in the biliary passages — the prime reason for the jaundice was no doubt the hepatitis. Nevertheless, it is possible that there was a relative impediment, consisting of an accumulation of tough mucus in the lower part of the common bile duct and/or adhesion of the mucosal surfaces, sufficient to obstruct the flow of bile which lay under subnormal pressure because of the hepatitis, and that the impediment was removed by the greater pressure caused by the perfusion. The hepatitis was made worse by the impeded flow of bile, the pressure of the bile dropped still more and a vicious circle developed. It is this vicious circle which was broken by the surgical intervention. A review of the literature shows that surgical therapy, though in another form — making a fistula to relieve the liver — has been used with success by other authors (VON HABERER, NORMANN and others) in severe cases of acute hepatitis with long-standing, advanced icterus. Because of these and his own observations the author recommends surgeons to adopt a more active standpoint as regards the treatment of this disease. The cases which should be operated on are the ones with an uncertain diagnosis (where biliary obstacles cannot be ruled out), and ones of sure hepatitis with severe icterus which does not diminish within a reasonable time and where there is a risk of acute yellow atrophy or cirrhosis of the liver. There are reasons to believe that active surgical therapy can save a number of these patients. First perfusion of the biliary passages in the form of cholangiography should be tried. Cholangiography must always be done anyway to confirm the diagnosis. If this does not have the desired result, there is always the possibility of making a fistula in the gallbladder afterwards. In the cases where there is an

impending danger of collapse of the liver function, cholecystostomy or drainage from the common duct should be done at the very beginning.

Zusammenfassung.

Verf. beschreibt 4 Fälle von Hepatitis acuta mit schwerem Ikterus, der durch interne Therapie nicht beseitigt werden konnte. Die Gelbsucht, die 7 Monate bzw. 2 Monate, 6 Wochen und 5 Wochen lang bestanden hatte, verschwand in allen 4 Fällen nach operativer Behandlung ziemlich rasch, und die Kranken wurden geheilt. Die chirurgische Behandlung bestand in Durchspülung der Gallenwege in Form von Cholangiographie — in einem Falle ausserdem Spülung mit physiologischer Kochsalzlösung. Zur Erklärung der Wirkung des chirurgischen Eingriffes hat Verf. folgende Hypothese aufgestellt. Die Cholangiographie zeigte zwar, dass ein gröberes mechanisches Hindernis in den Gallenwegen nicht vorlag — die Ursache der Gelbsucht ist sicherlich in erster Linie die Hepatitis. Man kann sich aber ein relatives Hindernis denken: Anhäufung von zähem Schleim in der unteren Partie des Choledochus, Aneinanderkleben der Schleimhautflächen, das stark genug ist, dem durch die Hepatitis unter unternormalem Druck stehenden Gallenstrom zu widerstehen, das aber durch den höheren Druck bei der Durchspülung beseitigt wird. Die Hepatitis wird durch die Erschwerung des Gallenabflusses verschlimmert, der Gallendruck sinkt weiter, und es kommt zu einem Circulus vitiosus — dieser Circulus vitiosus ist es, den der chirurgische Eingriff bricht. Eine Übersicht über das Schrifttum zeigt, dass chirurgische Therapie, wenn auch in anderer Form — Entlastung der Leber durch Anlegen einer Gallenfistel — auch von anderen Autoren (v. HABERER, NORDMANN u. a.) in schweren Fällen von Hepatitis acuta mit hartnäckigem, erstem Ikterus mit Erfolg versucht wurde. An Hand dieser und eigener Erfahrungen hält Verf. es für motiviert, bei der Behandlung dieser Krankheit von chirurgischer Seite einen aktiveren Standpunkt einzunehmen, als es früher der Fall gewesen ist. Zu operieren sind teils Fälle mit unsicherer Diagnose (wo sich ein Hindernis in den Gallenwegen nicht sicher ausschliessen lässt), teils Fälle von sicherer Hepatitis mit schwerem Ikterus, der nicht einigermaßen schnell zurückgeht, und wo die Gefahr eines Übergangs in akute gelbe Leberatrophie oder Leberzirrhose vorliegt. Man hat Grund anzunehmen, dass eine aktive chirurgische Therapie die Möglichkeit hat,

einen Teil dieser Kranken zu retten. Als Operationsmethode ist in erster Linie die Durchspülung der Gallenwege in Form der Cholangiographie zu versuchen, die ja sowieso immer vorgenommen werden muss, um die Diagnose sicherzustellen. Sollte dies nicht zum Ziel führen, so hat man immer die Möglichkeit, sekundär eine Gallenblasenfistel anzulegen. In den Fällen, wo man mit der drohenden Gefahr eines Zusammenbruchs der Leberfunktion rechnen muss, dürfte schon von Anfang an eine Cholezystotomie — oder evtl. eine Choledochusdrainage — vorzunehmen sein.

Résumé.

L'auteur décrit 4 cas d'hépatite aiguë avec ictère grave qu'on ne put faire rétrocéder par les moyens de la médecine interne. La jaunisse, qui avait existé pendant 7 mois, 2 mois, 6 semaines et 5 semaines respectivement, disparut dans tous les 4 cas assez vite après le traitement opératoire et les malades guérirent. Ce traitement chirurgical consista en irrigation des voies biliaires sous forme de cholangéographie — dans l'un des cas on y ajouta des lavages au sérum salé physiologique —. Pour expliquer l'effet de l'intervention chirurgicale l'auteur a émis l'hypothèse suivante: La cholangéographie, à vrai dire, ne montra pas l'existence d'un obstacle mécanique grossier au niveau des voies biliaires — la cause de la jaunisse, c'était certainement, au premier chef, l'hépatite — mais l'on peut se représenter qu'il y avait un obstacle relatif, tel qu'accumulation de mucus épais dans la partie inférieure du cholédoque, ou accollement des muqueuses, obstacle suffisamment important pour s'opposer à l'écoulement de la bile qui, du fait de l'hépatite, est sous une pression inférieure à la normale; cet obstacle est supprimé par l'accroissement de pression au moment de l'irrigation. L'hépatite s'aggrave par la gêne apportée à l'écoulement de la bile, la pression biliaire continue à baisser, il s'établit un cercle vicieux, et c'est lui que rompt l'intervention chirurgicale. Une revue de la littérature montre que le traitement chirurgical, quoique sous une autre forme — soulagement du foie par l'établissement d'une fistule biliaire — a été essayé avec succès par d'autres auteurs aussi (VON HABERER, NORDMANN, etc.) dans des cas graves d'hépatite aiguë avec ictère rebelle et grave. S'appuyant sur ces expériences-là et les siennes propres l'auteur estime justifié, de la part des chirurgiens, de prendre une attitude plus interventionniste que jadis dans le

traitement de cette affection. Les cas qu'il faut opérer sont d'une part ceux à diagnostic incertain (où l'on ne saurait exclure à coup sûr un obstacle au niveau des voies biliaires) et d'autre part ceux d'hépatite confirmée avec ictère grave qui ne rétrocede pas dans des délais acceptables, et où existe le risque d'un passage à l'atrophie jaune aiguë du foie ou à la cirrhose. Il y a des raisons de croire qu'un traitement chirurgical actif peut sauver une partie de ces malades. Comme méthode opératoire il faut en premier lieu essayer l'irrigation des voies biliaires sous forme de cholangéographie, puisque celle-ci, de toute façon, doit toujours être exécutée pour asseoir le diagnostic. Si elle ne conduit pas au but on aura toujours la possibilité de faire secondairement une cholécystostomie. Dans les cas où l'on doit compter avec le danger imminent d'un effondrement de la fonction hépatique c'est évidemment d'emblée que la cholécystostomie — ou éventuellement un drainage du cholédoque — devra être établie.

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Os Purum from Compact Substance and the Preparation thereof.

By

Dr. H. L. M. VAN DER HOFF,
Sittard, Holland.

This article deals only with O(s) P(urum) prepared from compact substance.

It will not be difficult, however, to transfer the ideas that are going to be developed to the sphere of the spongy substance, if one visualizes: firstly the structure of these two tissues and secondly the various purposes for which the O.P. from spongy substance and compact substance have to serve.

Here follow the reasons why the use of O.P. made from compact substance has been advised:

1) When the Haversian canals and bone cell cavities are empty, the tissue penetrating from the transplant bed need not first dissolve the organic substances from these cavities before the osteoblasts can begin their bone forming. So time is gained;

2) When the organic substances filling the canals are decomposed in the body itself, as is the case if no O.P. is used, undesirable substances which disturb the process of ossification, are liberated. This is all the more important because it is heteroplastic tissue already from the beginning containing albumens and fats which are, parenteral at least, foreign to the body of the host;

3) O.P. contains no substances foreign to the host (see the announcement of Pharmacia, Stockholm);

4) O.P. is more readily resorbed than bone which has not been previously prepared e.g. dry bone or bone which has only been boiled.

These arguments can be subjected to criticism.

Ad. 1. O.P. prepared from compact substance is, in the first place osteosynthetic. It lies on or in the bones of the patient, firmly fixed, or has itself a fixing function (compare: O.P. and operative fractures, Arch. f. Klin. Chir., Bd 202.)

Its function is synthetic and not plastic. If used in case of fracture for example, osteogenesis in the neighbourhood of the entire fracture planes is of primary importance for the success of the cure, and though osteogenesis occurring in the canals of O.P. cannot be called entirely worthless, yet it is only a factor of slight importance, the more so since the contents of the canals as compared with the total volume of the inserted piece of bone can only be called small.

Ad 2. That the products of decomposition of organic substances in the canals are detrimental to osteogenesis is an unproved statement. Many instances could be given of substances which, applied in larger quantities, react in another way than if only small quantities are used. The question is: what are the quantities concerned? At the same time one should consider that the products of decomposition of the organic substances are not all liberated at the same time. The fats and albumen in the central part of the bone are affected later than those of the periphery. Moreover it should not be overlooked that according to Swedish statements fresh rinder-bone contains 24.7 % organic matter and after the treatment which converts it into O.P. only 2.6 % less. Do not then the products of decomposition of the remaining 22.1 % form a danger to osteogenesis, and why must just this 2.6 % be removed then from the canals considering their poisonous action?

Neither has it been proved that the poisonousness of the decomposition products of heteroplastic matter is greater than that of autoplasmic matter. On the contrary, it seems more plausible to assume that the differences between animal and human albumen disappear as the process of decomposition progresses.

The argument about the harmfulness of the decomposition products seems to be rather unconvincing.

We have at our disposal a large series of operative fractures which in a very short time were clinically perfectly cured, osteosynthesis having been performed with bone which had only been boiled.

Ad 3. Also the thesis that O.P. does not contain matter foreign to the host does not seem to me to be tenable in this absolute, form. For, apart from the inorganic component parts, which we

too, consider to be identical in man and rind O.P. still contains round about 20% organic matter, consisting of collagenous fibrils, interfibrillar osteomucoid substance and elastic fibres and it is difficult to accept that only the albumens filling the Haversian canals should have this specificity, and that the other organic substances should be identical analytically and stereometrically.

Ad 4. That O.P. is more quickly resorbed than dry or boiled bone, is a statement than I can neither confirm nor contradict. We did not experiment in this field and experience with our patients is useless because the size of the piece of bone was different in every case and the patients differed too in all kinds of respects, also as regards the place of insertion.

We have, however, found by experience that if the seat of fracture is warm, the inserted bone, even when not O.P., can be resorbed very quickly (within a few months).

Should the seat of fracture be cold — and this is the most attractive condition in case of operative fractures — O.P. as well as unprepared bone may remain in place for more than two years to disappear only very slowly.

And supposing it were true that O.P. should disappear more quickly than dry or boiled bone, the fact that the one is resorbed — say in two years' time and the other in three years' time, can hardly be an argument in favour of the use of O.P. In the case of «old» fractures resorption in both cases takes much longer than a year.

The arguments in favour of the use of O.P. in preference to unprepared bone do not seem to be very strong. No argument can be adduced against its use, except its costliness. As, moreover, one would like to have it in a form that is not on the market, we have considered how we could prepare it ourselves.

The results of this research have been noted in the following article. They, at the same time, serve as preparatory study for experiments that can be made with *Os Novum*, which has quite other advantages than those ascribed to O.P. from compact substance to which the above criticism does not apply.

A. Method of Examination.

A short survey of the structure of normal compact substance, in so far as it is of importance to this examination, is desirable.

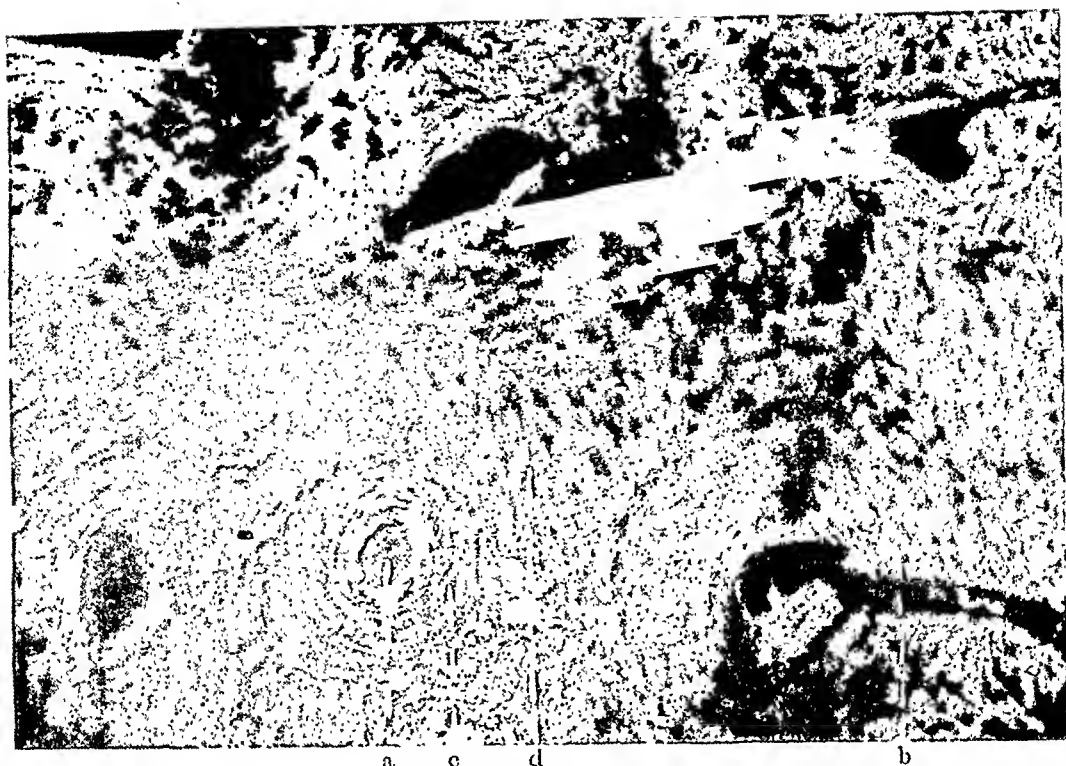


Fig. 1. Cross section of compact substance; ground section 0.2 mm. thick, linear enlargement 750 times.

a = Haversian canal, b = Volkman canal, c = Lamellae surrounding Haversian canal, d = Interstitial canal.

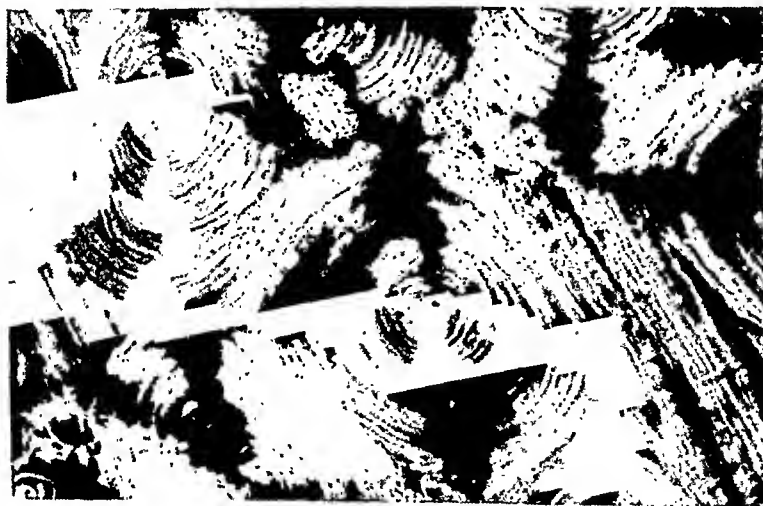


Fig. 3. Ground section, normal bone. Linear enlargement 200 times. Transversed light with crossed nicol-prisma.



Fig. 4. Cross section over-treated with lye. Linear enlargement 200 times. Transfused light with crossed nicol-prisms. Here and there traces are to be seen of the black cross which is clear in fig. 3.



Fig. 5. Cross section over-treated with lye. The lamellarian structure has almost entirely disappeared. There is still a trace of the bone-cell cavities. Percentage of N_2 is 3.8 %. The bone is still very firm. Linear enlargement 310 times.

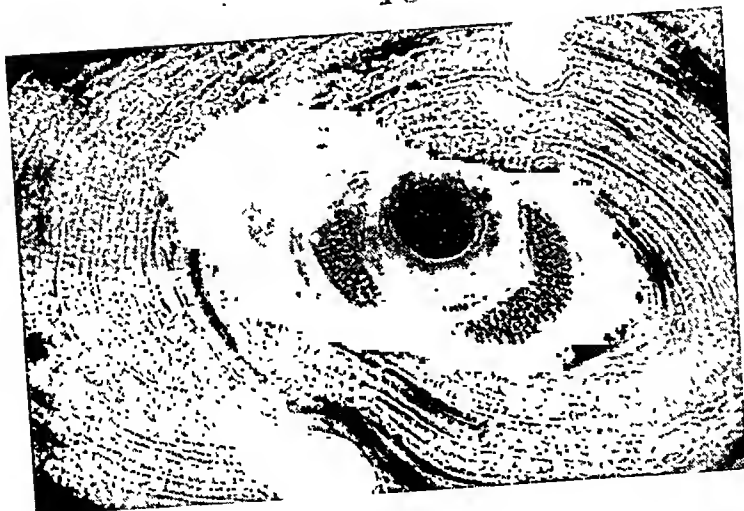


Fig. 6. Micro-photo. Section coloured according to van Gieson's method. Bone too strongly attacked by lye. Linear enlargement 780 times. The lamellae are still present, but the structure is granular. There is no trace of bone-cell cavities.



Fig. 7. Cross section by reflected light. Linear enlargement 730 times. Compact substance too strongly treated with lye. The bone cell cavities and their appendages are losing their sharp outlines. cf fig. 11.

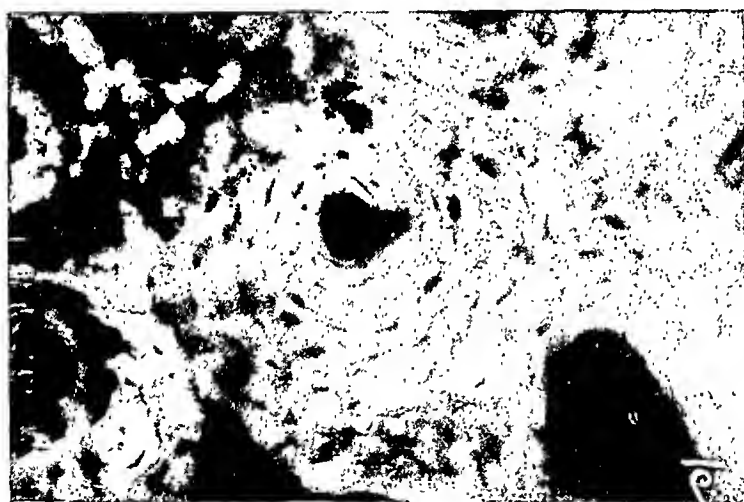


Fig. 8. Cross section. Bone treated with trypsin. Transfused light. Linear enlargement 310 times. The structure is quite intact. Other photos prove that the Haversian canals are empty.



Fig. 10. Compact substance after acetone-lye treatment. Photo with transfused blue light. Every division is 7.3 micron. The cell-cavities are intact. Also the radiating lines of the cell-appendages are clearly to be seen.



Fig. 11. Cross section by reflected light. Linear enlargement 730 times. Compact substance will treated with lye. The cell cavities and their appendages kept their sharp outlines.

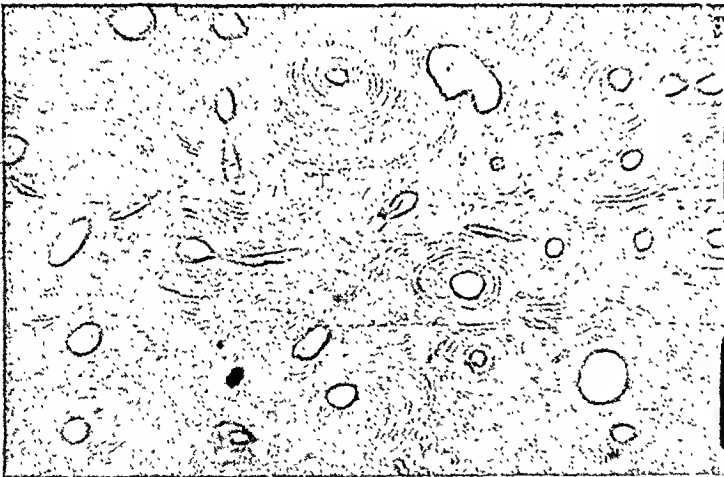


Fig. 12. Micro-photo. Congo-red. Linear enlargement 70 times. The Haversian canals are empty. The lamellar system is clearly to be seen.

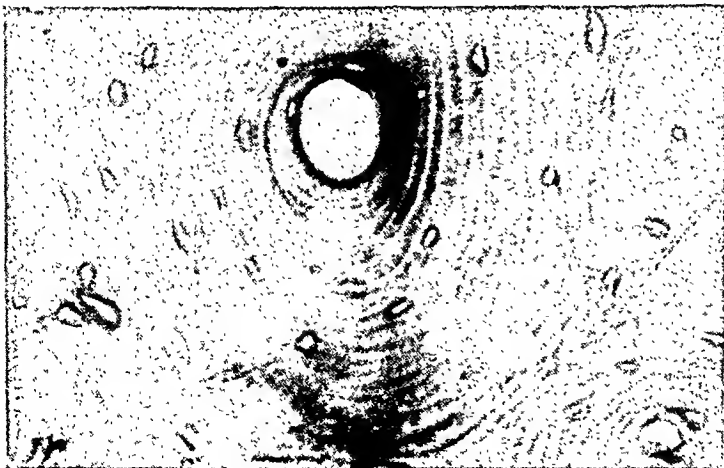


Fig. 13. Micro-photo. Haemat. Eosine. Linear enlargement 780 times. The cell cavities are empty.

On examining a ground section of a long bone in cross section one sees the section of the Haversian canals (fig. 1). Circularly around these canals are a number of lamellae. These Haversian canals run in the direction of the longitudinal axis of the bone. In between these Haversian systems there are a number of so called interstitial lamellae. The Volkman canals connect the Haversian canals; they have no lamellae around them and in cross section of a long bone they are wholly or partially cut in their longitudinal direction. On the outside of the long bone one finds a number of basic lamellae which covers the whole outside. In the canals there are blood vessels. Fig. 2 gives a schematic view of a Haversian system. In the lamellae collagenous fibres disperse, which in a cross-section in the contiguous lamellae form an acute angle with the plane under consideration, but each running in another direction. Between the planes of these lamellae lie the bone cells with their fine off-shoots.

The fibrils are surrounded by the so-called osteomucoid substance. The calcium salts, as we see by the crystallogram, consisting especially of apatite are found, if not exclusively, then at least for the greater part, in this osteomucoid substance.

In our examination the following methods will be considered:

1. *Chemical*: the determination of the percentage of organic substance by finding the percentage by weight of N_2 as compared with the dry substance. By multiplying this number by five, the percentage of organic matter is obtained.

2. *Microscopic*: the preparation of microscopic slides coloured according to van Gieson's method and with haematoxylin-eosine; secondly the preparation of ground sections.

The van Gieson's method colours the collagene red whereby the changes in the collagene become noticeable. The colouring with Haem.-eosine gives us information especially about the cells in their cavities and about the contents of the Haversian canals.

In both cases — microscopic sections and ground sections — the investigation will concern the following points:

a. Whether the Haversian canals and bone cell cavities are empty;

b. The relative clearness of the structure of the lamellae; because experience shows that this structure becomes clearer in the sections according as the fibres are more affected. This is only true, however, up to a certain limit. When this limit is exceeded the whole lamellar system disappears;

c. The greater or lesser degree of granulation. When the lamellar system is affected, the Gieson method which especially colours the collagene, shows fine grains, presumably collagenous fibres in section;

d. *Polarization.* In normal bone the properties of the collagenous fibres and their special position in relation to each other, produce an extraordinary field of vision, when Nicol prisms are used. It stands to reason that this image will change when the collagenous fibres are affected, and owing to the shiftings in the whole mass, also change their position in relation to each other.

3. *Bearing power:* The O.P. that we prepare is subjected to a load test by bending to ascertain how much of its bearing power it has lost during and owing to the purification. The way in which this is determined is described in the above mentioned article. (Arch. f. Kl. Chir., Bd. 202, v. d. Hoff: O. P. and operative fractures.)

4. *Changes in the Crystalline state:* Crystallograms of compact substance were made before and after the process of changing it into O.P.

B. The Properties which O. P. Made from Compact Substance Must Possess.

- 1) The Haversian canals and bone cell cavities must be empty;
- 2) The percentage of albumen must decrease as much as possible;
- 3) The firmness of the bone must remain unchanged or at least be affected as little as possible.

Ad 1. Whether canals and bone cell cavities are empty, is best seen in the sections coloured with haemateos, or according to v. Gieson's method. Ground sections are of no use for this purpose, because the grindings fill the holes and therefore produce the characteristic view of a ground section. It is not difficult to prepare O.P. that has empty canals (see below). The O.P. that is on the market also meets this requirement. Only here and there is there a coating on a cell cavity. If this were the most important criterion of good O.P., one had better take boiled or desiccated bone. This is more easily prepared than O.P. and although under microscopic examination the mass still proves to be present in the canals and cell bone cavities, it is so much shrunk that the advancing osteoblasts would not meet with any appreciable mechanical obstacles.

Ad 2. According to Swedish statements, when treated with aceton-lye the percentage of organic matter in the compact substance falls from 24.7 % to 22.1 % = 4.94 % N₂ to 4.42 % N₂:

It is difficult to get absolutely correct data on this subject. Several times I have found by repeated checking, that pieces of compact substance lying close together showed differences of from 4.15% to 4.51% N_2 .

But even if we accept the statements about the drop from 24.7 % to 22.1 % organic substance to be correct, then it is not yet proved that this has been caused by the cleaning of the canals and the bone cell cavities. I have found that the percentage of N_2

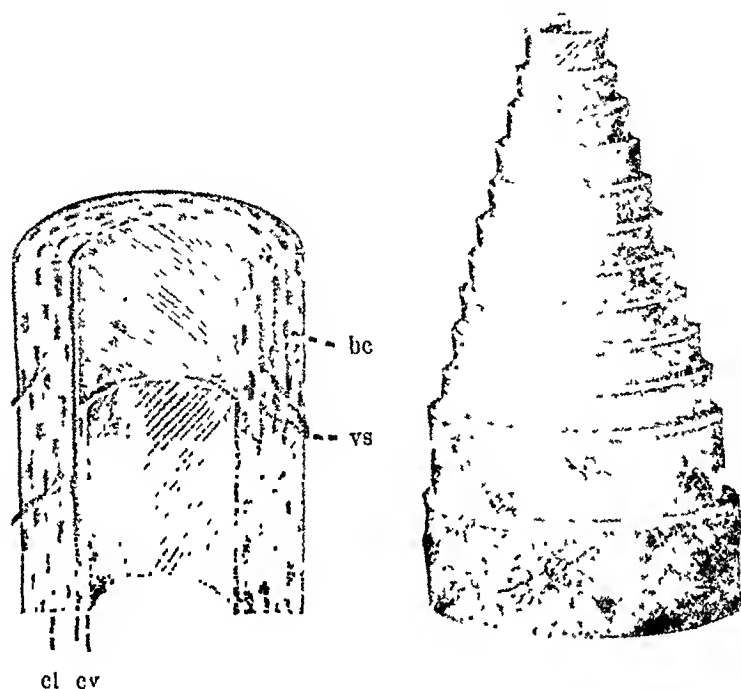


Fig. 2. (Copied from the "Leerboek der Algemeene en Byzondere weefseller Boeke — de Groodt — Heringa".)

bc = bone-cells, cl = collagenous lamellae, cv = collagenous fibres,
vs = Sharpey fibres.

does not fall during the examination of compact substance, if the bone is only cleaned mechanically, and neither does the percentage of N_2 fall — at least not usually — if compact substance is moreover exposed to treatment with trypsin in which case the canals and cell bone cavities get empty, but the remaining organic substance is not appreciably affected.

In other words the decreases of organic substances, after having been treated with aceton-lye is — at least partly — due to the more specific structure of the bone being affected.

This hypothesis is supported by the fact that in other ways, too,

there is evidence that the structure is affected. Both the usual microscopic section and the ground section of normal bone show — in connection with the peculiar situation of the collagenous fibres — the typical polarization image. In the case of O.P. as it is put on the market, this image has either disappeared or has greatly weakened. Consequently the collagenous fibres and (or) the osteomucoid substance have also been affected. The fibres changed or were displaced, owing to which the image disappeared (fig. 4). The same is shown in another way too. When too strong lye concentrations have been used then one finds strong granulation of the lamellae (especially clear in v. Gieson preparation). It gives one the impression of looking at a section of all the fibres. The granulation — a sign that the structure of the bone has been strongly affected — is already found very soon even when the concentration of lye is weak.

This points to the fact that the acetone-lye method is always attended by affection of the specific bone structure (fig. 6).

Ad 3. One asks oneself if the bone remains firm when the specific structure is seriously affected.

Fig. 5 represents a ground section in which every lamellar structure has disappeared. The percentage of N_2 was 3.8 % (19 % organic matter). Therefore the structure may have suffered seriously if the percentage of N_2 is still high. With the naked eye one notices nothing extraordinary about such a piece of bone. Fig. 6 gives a microphoto of a similar piece. The strong granulation also points to damaging of the constructive elements.

If one examines in how far destruction can be increased before mechanical changes are registered, it appears that the percentage of organic substances can fall to 8 % or 10 % (1.6 or 2 % N_2) before a piece of bone of some thickness becomes obviously brittle.

C. The Removal of Albumens.

The albumens are digested in pepsin, in trypsin or destroyed in lye.

Pepsin acts in an acid medium. If one takes concentrated H.Cl. as is usual when a julapium is prescribed, then one has about 0.04 Normal. It takes some time for the pepsin solution to penetrate into the Haversian canals and in that time the H.Cl. also dissolves the $Ca_3(PO_4)_2$ of the bone. This is a rapid action.

Pieces of bone with an area of 3 sq cms were brought into contact with 30 c.cs of H.Cl. of various concentrations, for 18 hours at a temperature of 40°C (Table I).

Table I.
Results after 18 hours.

H.Cl. solution (norm.)	Weight of piece of bone in mgs.	Dissolved Calcium	
		mgs.	% by weight
0.5	380	95.4	25
0.1	430	42.4	10
0.01	470	7.2	1.5
0.005	240	3.9	1.6
0.001	254	0.7	0.28
0.0005	265	0.2	0.08

The pieces of bone were again brought into contact with H.Cl. solutions of the given strengths. The results of this second period are given in Table II.

Table II.

H.Cl. Solution (Norm.)	Dissolved Calcium	
	mgs.	% by weight
0.01	11.1	3.1
0.005	3.5	1.1
0.001	0.8	0.32
0.0005	0.3	0.11

If, therefore, one wants to expose a piece of bone to the action of pepsin in H.Cl. solution of 0.04 N for seven days one must count on an almost complete solution of the Ca. if, at least, sufficient acid remains present which is necessary for the proper action of the pepsin. This pepsin method is impracticable.

Trypsin works in an alkaline medium and therefore does not dissolve the Ca. Just as is the case with pepsin, it does not affect the collagenous fibrils and elastic fibres and affects the interfibrillar-osteomucoid substance only superficially because the trypsin cannot reach it.

Trypsin is destroyed by a pH = 12. If one should want a longer period of action one should choose pH = 9.5. This is obtained when to 20 cc of 1 % Merck-trypsin. 75 cc NaOH of 0.12 N is added. This is more lye than one calculates, the cause of which is

to be found in the strong lye-combining properties of trypsin. A few drops of toluene are added to the solution to prevent mould. As indicator thymo-phtaleine may be used (9.3 colourless 10.5 blue) but it is better to take the hydrogen-electrode. The latter indicates more clearly.

If albumens are digested by trypsin, amino-acids are liberated, which combine with alkali. For this reason lye should be added daily; in a fortnight nearly as much as the quantity with which one started, when one puts a few pieces of bone in 20 cc trypsin-lye solution. Because an aqueous solution of lye is added, the percentage of trypsin drops. Consequently this substance must be added, too, to keep the action constant.

This method is rather cumbersome and therefore not to be recommended. If, however, a few pieces of bone are put in a »trypsin-lye» solution (trypsin Merck 1%; lye pH 9.5, and a few drops of toluene, (see above) for a fortnight at a temperature of 37°, the Haversian canals and the cell bone cavities of the compacta are empty.

We have not examined this method any further. It is quite possible that an action of short duration is also sufficient. The structure of the bone is kept intact (fig. 8).

Acetone-Lye Method.

Acetone. In some publications one reads that the pieces of bone were first treated with lye and then with acetone. This is not correct. Lye changes fat into soap and soap does not dissolve in acetone. The treatment with acetone should precede the one with lye. Owing to the solution of the fats, the lye has easier access to the albumens. We have repeatedly set up experiments with lye treatment, in double series — one with and one without acetone action. It always proved that the pieces treated with acetone showed better and earlier signs of purification and — when concentration and time were increased — also of total destruction than when there was no previous treatment with acetone.

The pieces are cleaned externally by means of acetone and are put for a week in excess acetone (1 gram bone, 10 to 20 g acetone, shake now and then). This is amply sufficient, which is proved by fig. 9. After 48 hours the extraction of fat does not increase any more. The experiment is made as follows: in a small dish lies a piece of compact substance. On this fresh acetone drops continually.

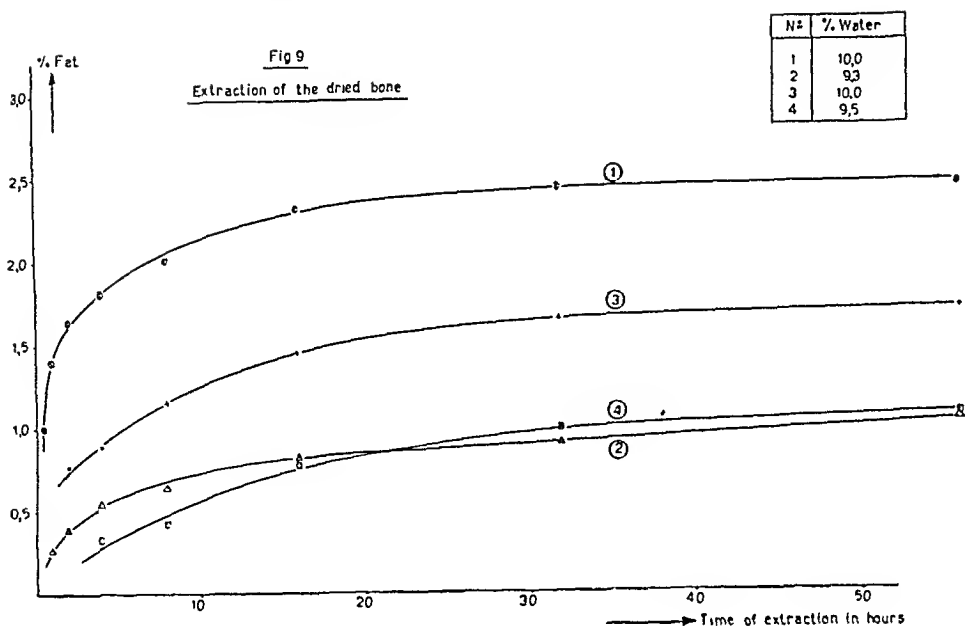


Fig. 9.

When the dish is full it overflows on to a second dish. The second dish is heated and by means of a condenser the escaping acetone is returned to the first dish, on which it drops as fresh acetone. After 2—4—8 etc hours the contents of the second dish are entirely evaporated and in this way the quantity of fat extracted is ascertained. After 32—48 hours the quantity does not increase any more. We shall not occupy ourselves with the question whether there is any fat still left in the bone. In this way, in any case, no more can be extracted.

If pieces of compact substance are put in acetone, and are shaken every now and then, one has approximately the circumstances of the experiment. For, if a piece of bone contains 2.5 % fat and a quantity of acetone is taken equal to from 10 to 20 times the weight of the bone then the acetone finally only contains from 0.25 % to 0.125 % fat i.e. the acetone remains almost entirely fresh.

Lye.

The outside of the bone is attacked soonest by lye because the lye reaches it first. One can convince oneself of this fact by putting a long bone on a lathe, giving a cylindrical shape, closing up the marrow canal with cement and then placing the whole in boiling lye of 0.5 normal, during, say 1 hour. If then two layers are taken

off the bone by grinding, each layer 1 mm thick, the outside one proves to contain about 2.61 % N_2 and the inner one about 4.51 % N_2 . Consequently, in order to make O.P. the solution of lye must be weak and the time of treatment long, so that the lye gets time to penetrate into the canals and the question which layer is reached first does not play an important part any more.

The difficulty of reaching the inner layers can also be solved in another way. If a piece of bone is put in acetone under reduced pressure of about 150 mm Hg. (boiling point) and in diluted lye under a pressure of about 10 mm Hg. and if then air is allowed to flow in, the air pressure forces the acetone (the lye) into the canals and the bone cell cavities. This method proved to be too radical. Probably gases were sucked from the collagenous fibres and the surrounding substances, so that, contrary to plan, the lye attacked the collagenous fibres as quickly as the Haversian canals. We discontinued this method especially when it proved that also without pumps a good result could be obtained.

In order to decide what strength should approximately be taken, we first made some preparatory tests which are noted in Table III.

Table III.

Pieces of bone were boiled with 30 cc NaOH of different strengths in a returning condenser.

Decrease in the percentage of N_2 .

NaOH solution strengths (norm.)	Weight of piece of bone in mg.	Total% by weight of N ₂ in relation to the dry substance.		
		original	after boiling	decrease
After boiling for 1 hour				
1	354		1.74	2.62
0.5	296	4.36	3.24	1.12
0.01	400		4.11	0.25
After boiling for 4 hours				
0.1	357		3.73	0.63
0.01	337	4.36	4.32	0.04
After extraction for 1 hour in boiling acetone and then boiling for four hours				
1	560		0.20	4.11
0.1	480		3.81	0.50
0.01	470	4.31	4.28	0.03

If therefore a decrease of 0.5 N_2 is to be obtained one should apply strengths of about $1/5$ Normal, roughly speaking.

Roughly speaking, too, boiling for 4 hours can be taken as having the same effect as a treatment for six weeks at a temperature of 20°C. After that a new double series of experiments was made (with and without acetone). The strengths of the lye solutions were 1/40 to 1/20 Normal.

The period of action varied from 1 to 6 weeks.

Table IV.

	1 week	2 weeks	6 weeks
1/40 N.	No. 1	No. 2	No. 3
1/20 N.	No. 2	No. 5	No. 6
1/10 N.	No. 7	No. 8	No. 9
1/5 N.	No. 10	No. 11	No. 12
1/2 N.	No. 13	No. 14	No. 15

Much lye must always be taken, otherwise a neutral solution will be found in a few weeks because the albumen combines with the lye, so that one is not sure how long the lye has acted.

Every now and then a few drops of strong lye are added in order to maintain the strength of the solution. (Check the strength.)

After the treatment of the 2 ee pieces was finished, the Nos 13, 14 and 15 proved to be brittle. No. 12 was firm, from which follows that 1 week in 1/2 N. lye has a stronger effect than 6 weeks in 1/5 N lye. Of a number of pieces the % of N₂ was determined (Table V). It is numbered in the same way as Table IV. The addition of «a» means that they were previously treated with acetone.

Table V.

Percentage by weight of Nitrogen.

Sample	Percentage by weight of N ₂	Sample	Percentage by weight of N ₂
1	4.1	1a	4.0
2	4.0	2a	4.3
3	4.0	3a	4.1
5	3.3	5a	4.1
8	4.0	8a	4.2
10	3.8	10a	4.15
11	4.0	11a	4.1
12	3.9	12a	3.9

As regards the percentage of albumen, it is therefore of little importance which percentage of lye and what length of time is chosen; at least within the limits indicated by the above table.

Nevertheless there proves to be a difference as to the contents of the canals, and this, too, points to the fact that the destruction of the albumens filling the canals and the bone cell cavities, is of little importance as regards the total drops in the % of Nitrogen in the compact substance (see above).

If one views these sections microscopically, Nos 3 and 3a, prove to be the first to have completely empty canals and bone cell cavities. Higher in the series this is also the case, it is true, but then the specific structure of the bone gets more and more affected (granulation in the lamellarian system; gradual disappearance of polarization etc.).

Therefore for the emptying of the canals and bone cell cavities in compacta we choose a 6 weeks treatment in excess lye solution of 1/40 N. which is checked now and then and kept at the given strengths.

The figs. 10, 11, 12, 13 represent the results of the O.P. obtained in this way. The Haversian canals and bone cell cavities are empty. The structure is intact. Even the projections of the bone cell cavities are very clearly to be seen.

D. Crystallograms Were Made (fig. 14) of human and animal bone, before and after treatment with acetone lye. The photographs are identical. The lines in the photographs of human O.P. are somewhat sharper because it was purified slightly better. The first three sections were first treated with lye and then pulverized, the fourth section was first pulverized and then treated with lye.

E. Examination of the Flexibility Tests. For the method used in this examination, I refer to the article already mentioned.

It proved that the bone treated in the above mentioned way had not lost any of its bearing power in a bending test.

F. Animal or Human Material. If one looks at the chemical analyses of both (HAMMARSTEN, *Lehrb. der Phys. Chem.* 9. impression), the differences proved to be so slight that they can, perhaps, be explained already by the local variations in the bone itself (see above). The crystallograms as can be expected, are identical, and after the treatment with acetone, lye and after sterilization, the existing differences in the organic substances will be levelled.

It is difficult to believe that the products of decomposition of two pieces of bone so closely resembling each other, will show

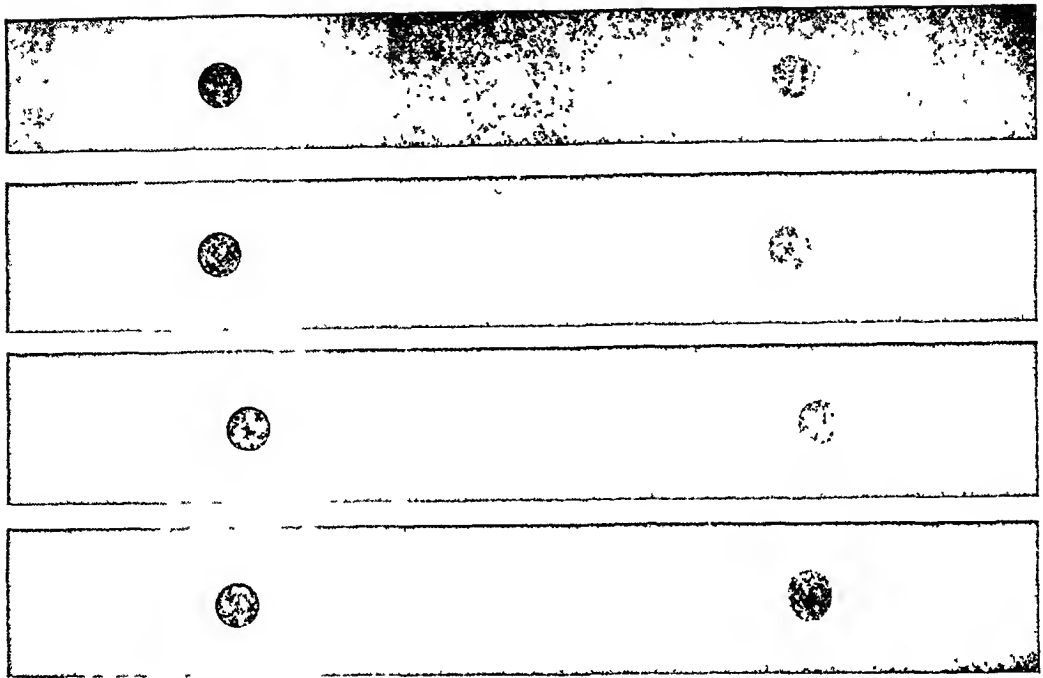


Fig. 14. Rinder bone — mechanically cleaned — filings.

II. Rinder bone — os purum from Sweden — filings.

III. Human compact substance — boiled — filings.

IV. Human compact substance — dried — to a powder.

differences of importance — either in positive or negative sense for the surroundings in which they are placed. Therefore I believe that it can be safely taken that there is no disadvantage for the patient if animal bone is taken for the preparation of O.P.

Summary.

Writer has not much faith in the advantages which Os Purum is said to have, when used in operating fractures, as fixing material. It is of little or no importance whether the Haversian canals and bone-cell cavities are empty. That the products of decomposition of organic substances, in the manner in which they are liberated, are injurious to osteo-genesis, is an unproved theory.

Moreover, after the so-called purification of Os Purum from compact matter 22 % of the 24 % organic substances remain, and these 22 % are just as injurious. Boiled and dried bone probably keeps a little longer than Os Purum before being resorbed, but those differences are not important e.g. 3 years instead of 2 years.

Os Purum as raw-material for Os Novum may have a future, and therefore this study on making Os Purum, about which so little literature is to be found, was started.

Methods of investigation: chemical (determination of percentage of N_2); microscopic (section and cross sections) special attention being paid to the degree of clearness of the lamellarian construction, granulation of structure and polarisation-vision. Bearing power and crystallographical changes are determined.

Stated as theoretical possibilities for the removal of the albumens are: HCl pepsin (useless owing to HCl); lye-trypsin (useless owing to cumbersome treatment) and the acetone-lye method. For details of each of these methods the reader is referred to the original article.

Finally it is stated that an excellent preparation is obtained when — as far as the compact substances are concerned — the bone is first cut into pieces of the shapes desired, then cleaned externally, next put in excess of acetone (from 10 to 20 times the weight of the bone) and finally for 6 weeks in 1/40 N. lye at normal temperature. This lye must be kept at this concentration, and be checked by means of hydrogen-electroids or colour-indicator. Many microphotos and details in the original article.

Zusammenfassung.

Der Verfasser glaubt nicht viel von den Vorteilen, die man meint, Os Purum beim Operieren von Frakturen beimessen zu können. Dort wird es als fixierendes Material gebraucht, und es ist von geringer oder keiner Bedeutung, dass die Haverschen Kanäle und Zelllöcher leer sind. Dass die Abbauprodukte organischer Stoffe, auf der Weise, in welcher sie dort freikommen, für die Osteogenese schädlich sind, ist eine unbewiesene These.

Ausserdem bleiben nach dem sog. Reinigen bei Os purum aus Kompakta 22 % von den 24 % organischer Stoffe übrig, und diese 22 % sind doch ebenso schädlich. Gekochter und getrockneter Knochen bleiben vielleicht wohl etwas länger liegen als Os purum, vor Resorption erfolgt, aber diese Unterschiede sind nicht erheblich, z. B. 3 Jahre statt 2 Jahre.

Os purum als Rohstoff für Os novum hat vielleicht wohl eine Zukunft, und daher wurde diese Studie über das Herstellen von Os purum, worüber in der Literatur so wenig Einzelheiten zu finden sind, verfasst.

Untersuchungsmethoden: chemisch (N_2 bestimmen); mikroskopisch (Schnitte und Schleifpräparate), wobei im besonderen auf das mehr oder weniger Deutlichwerden des lamellaren Baues, das Körnigwerden der Struktur und das Polarisationsbild geachtet wird. Auch werden Tragkraft und kristallographische Veränderungen bestimmt.

Als theoretische Möglichkeiten, die Eiweisse zu entfernen, werden HCl-Pepsin (unbrauchbar wegen HCl), Laugen-Trypsin (unbrauchbar wegen umständlicher Behandlung) und die Acetonlauge-Methode angegeben. Für die Einzelheiten jeder dieser Methoden lese man das Original.

Schliesslich wird mitgeteilt, dass man ein ausgezeichnetes Präparat erhält, wenn man — was die Kompakta betrifft — erst den Knochen in Stückchen von der gewünschten Form bringt, diese auswendig reinigt, sie danach 8 Tage in eine Übermass Aceton (10—20 mal das Gewicht des Knochens) und schliesslich 6 Wochen bei Zimmertemperatur in 1/40 N.-Lauge legt. Diese Lauge muss auf derselben Stärke gehalten und mit Wasserstoffelektrode oder Farbenindikator kontrolliert werden. Viele Mikrophotographien und Einzelheiten finden sich im Original.

Résumé.

L'Auteur n'attache pas grande importance aux avantages que l'on attribue à l'Os Purum pour les opérations des fractures. Il y est employé comme fixatif, et il importe peu, et même pas du tout que les canaux de Haver et les cavités des cellules soient vides. Que les débris des matières organiques, de la façon dont ils sont éliminés, soient nuisibles à l'ostéogénèse, c'est là une thèse dénuée de fondement. De plus, après le soi-disant nettoyage de l'Os Purum formé des compacts, 22 des 24% des matières organiques subsistent, et ces 22% sont aussi nuisibles que le tout. Lorsqu'on fait bouillir et sécher les os, la résorption se fait peut-être plus lentement que la résorption d l'Os Purum mais la différence n'est pas d'importance par exemple c'est une question de trois ans au lieu de deux.

Il est possible que l'Os Purum employé comme matière première pour obtenir l'Os Novum, soit appelé à survivre dans les temps à venir, et c'est aussi la raison d'être de cette étude sur l'Os Purum au sujet duquel on trouve si peu de détails dans la littérature.

L'examen peut se faire au moyen de deux méthodes: la méthode chimique qui sert à déterminer la N_2 ; la méthode microscopique (préparation de coupe ou de polissage) où l'attention se porte spécialement au plus au moins de clarté de la structure lammellaire — à la granulation de la structure — et à la polarisation. La force portative et les variations cristallographiques y sont également déterminées.

Comme possibilités théoriques pour faire disparaître l'albumine, on propose la pepsine HCL (inutilisable à cause du HCL); l'alcali trypsine (inutilisable à cause de traitement compliqué) et la méthode de l'acétone alcali. Que l'on veuille bien, pour les détails concernant chacune de ces méthodes, s'en rapporter à l'original.

Enfin il y est dit dans l'article que l'on obtient une préparation excellente quand, pour ce qui regarde la compacte, on donne aux morceaux d'os la forme désiré; ensuite on les met durant huit jours, dans un excédant d'acétone (10—20 fois le poids de l'os) et enfin durant six semaines, à température de chambre, dans 1/40 N. de soude alcali. Tenir cet alcali à niveau, contrôler à l'électrode Hydrogène ou un indicateur coloré.

Dans l'original on trouvera beaucoup de photos prises au microscope et des détails.

Aus der Pathologischen Abteilung des Karolinischen Krankenhauses.
(Vorstand: Prof. Dr FOLKE HENSCHEN.)

Über Pyelonephritis xanthomatosa.

Von

STURE ÖSTERLIND.

Wie seit langem bekannt ist, können unter gewissen Umständen bei chronischen Entzündungen und im Granulationsgewebe Lipoidsehr reichlich auftreten. Bei chronischer eitriger Salpingitis kann die Lipoidablagerung so stark werden, dass man von einer Salpingitis chronica xanthomatosa sprechen darf (PICK u. a.). Gleichartige Veränderungen können sich nach PICK u. a. bei Pachymeningitis finden (Pachymeningitis interna xanthomatosa) und nach LUBARSCHE »besonders häufig bei chronisch eitrigen Brustdrüsenentzündungen«. Auch die Lipoidablagerungen bei gewissen chronischen Pneumonien wären hier zu nennen.

Im Bindegewebe des Nierenbeckens treten Lipoidmassen unter verschiedenen Umständen auf. Bei allgemeiner Xanthomatose kann man im Nierenhilus und um die Ureteren eine ausgeprägte Gelbfärbung des veränderten Fettgewebes finden (z. B. HENSCHEN, Fall 1), welcher im mikroskopischen Bilde ein charakteristisches riesenzellenhaltiges, grossenteils anisotropes Granulationsgewebe entspricht. Vor allem aber bei *chronischer eitriger Pyelitis und Pyelonephritis* beobachtet man derartige Lipoidablagerungen im Nierenhilus und auch im Nierenparenchym. Es möchte sich für solche Fälle die Bezeichnung »*Pyelonephritis xanthomatosa*« empfehlen, welche m. W. noch nicht angewandt worden ist.

Diese eigenartige und verhältnissmässige seltene Variante der chronischen Pyelonephritis wurde bisher noch wenig beachtet, obwohl sie — besonders in pathogenetischer Hinsicht — grosses Interesse darbietet; daher will ich hier etwas näher auf dieselbe eingehen.

Mehrere Autoren fanden bei eitriger Pyelitis zuweilen Xanthomzellen in der Wand des Nierenbeckens. Im grossen ganzen scheinen sie nur in spärlicher Menge vorhanden gewesen zu sein und gleichzeitig mit anderen, stärker hervortretenden pathologischen Veränderungen. Nach PUTSCHARS Angabe bilden sich bei lange bestehender Pyelonephrose Granulationsmassen im Nierenbecken und in den Papillenspitzen, wobei Xanthomzellen in mehr oder weniger reichlicher Menge zu finden sind. Ferner beobachtete PUTSCHAR derartiges Granulationsgewebe mit reichlichen Lipoiden auch im Nierenparenchym, sogar in solchem Ausmass, dass das Parenchym in diesem Gebiet einen makroskopisch wahrnehmbaren gelblichen Farbton angenommen hatte. TH. SCHULTHEIS fand bei der Untersuchung von 26 infizierten Steinnieren ebenfalls in 3 Fällen Xanthomzellen in geringer Menge. W. SCHULTHEIS beobachtete Xanthomzellen in 1 Fall von 108 untersuchten Nieren. Auch dieser Fall betraf eine infizierte Steinniere. GRUBER fand ebenfalls bei chronischen Pyonephrosen Haufen von Xanthomzellen, welche teilweise auch doppelbrechende Substanz enthielten. Nach einer Angabe von LUBARSCH treten Xanthomzellen besonders bei Pyelitiden auf, welche durch Staphylokokken oder vielleicht auch durch gewisse Koli-arten hervorgerufen sind. Auch andere Forscher fanden gelegentlich Xanthomzellen bei chronischer Pyelitis. Im grossen ganzen scheinen diese Befunde jedoch spärlich oder nur recht mässig ausgesprochen gewesen zu sein.

Nach den vorliegenden Angaben soll es sich oft um isotope Lipoiden handeln; in einigen Fällen wurde gleichzeitig auch doppelbrechende Substanz beobachtet. In seltenen Fällen wurden Cholesterinkristalle nachgewiesen.

Eigene Kasuistik.

Fall I. K. H. 37jährige Frau. *Klin. Diagnose:* Pyonephrosis sin. c. lithiase.

Völlig gesund bis vor einem Jahre. Bekam damals nach einem Partus Beschwerden seitens der Harnwege welche seither fortbestanden haben (bohrender Schmerz, Harndrang, zeitweise Fieber und Schüttelfrost). Schmerzen über der linken Nierengegend. Der Harn enthielt reichlich weisse Blutkörperchen, aber keine Bakterien. Heller pos. Katheterharn aus dem linken Ureter zeigte den gleichen Befund. Bakterienkultur neg.

Operation: Nephrektomie (Prof. HELLSTRÖM).



Abb. 1. Schnitt durch die Niere, Fall 1. Die xanthomatösen Veränderungen treten als helle, fast weisse Gebiete hervor. Nat. Gr.

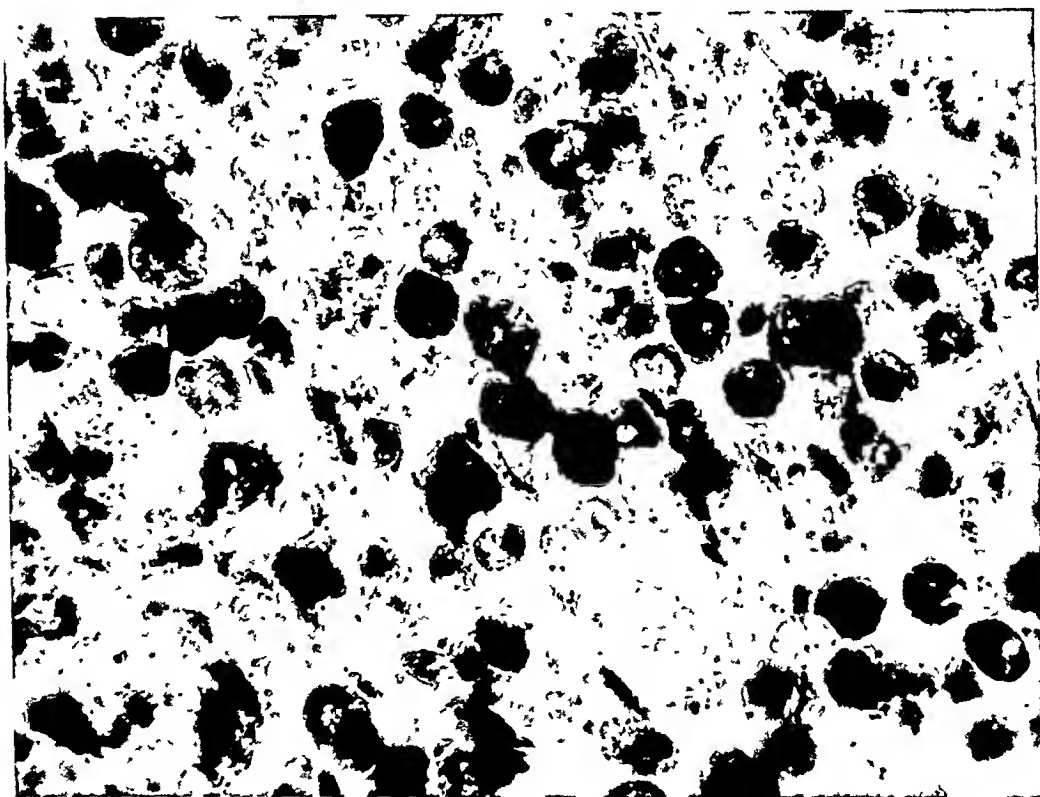


Abb. 2. Sudangefarbttes Schnitt aus dem Bindegewebe des Nierenhilus im Fall 2. Grosse runde Fettphagozyten mit z. T. anisotroper Substanz; auch kristallinische Einschlüsse kommen vor.

ÖSTERLIND: Über Pyelonephritis xanthomatosa.

Makroskopischer Nierenbefund: Die Niere misst ea. 17 cm in der Länge und ca. 10 cm. in der Breite. An der Oberfläche mehrere grosse Abszesses. Nierenbecken erweitert, mit Eiter gefüllt; Ureteren gedehnt. Im Nierenbecken ein grosser Stein (ca. $3\frac{1}{2} \times 5\frac{1}{2}$ cm). In den Kelchen am unteren Nierenpol zwei erbsen- bis bohlangrosse Kalkkonkremente, teilweise im Nierenparenchym selbst gelegen. Im Mark zahlreiche, herdförmige Ablagerungen, einige über walnussgross, von schwach gelber Farbe und fettähnlicher Konsistenz (Fig. 1). Das Fettgewebe in der Nähe der Nierenbeckenschleimhaut in ähnlicher Weise verändert.

Mikroskopischer Nierenbefund: Das Nierenparenchym ist nahezu gänzlich durch ein zellreiches Granulationsgewebe ersetzt. Glomeruli und Tubuli praktisch vollständig zerstört. In den wenigen erhalten gebliebenen stellenweise feine Fetttropfen in den Zellen. An Kapillaren und Arteriolen ebenfalls hochgradige Degeneration; stellenweise feine Fetttropfen in den Zellen. Das erwähnte Granulationsgewebe geht gegen das Nierenbecken hin in ein äusserst lipoidreiches Xanthomzellengewebe mit starker Anisotropie über. Nierenbeckenepithel grösstenteils zerstört und durch Granulationsgewebe der bezeichneten Art ersetzt.

Fall 2. A. R. N. 56jähriger Mann. Klin. Diagnose: Pyonephrosis sin. e. lithiasis.

Völlig gesund bis vor 3/4 Jahren. Lag damals ea. 1 Monat im Krankenhaus wegen Beschwerden seitens der Harnwege (leichte Cystitisbeschwerden, subfebrile Temperatur, eitriger Harn). Hat seitdem keine anderen subjektiven Beschwerden als Mattigkeit. Bei ernster Untersuchung wurde links im Bauch ein reichlich kokosnussgrosser, grobbuckliger, nicht druckempfindlicher Tumor getastet, welcher vom Sitz der linken Niere ausging. Im Harn fanden sich massenhaft weisse Blutkörperchen sowie reichlich Staphylokokken. Heller pos. Katheterisierung des linken Ureters entleerte gelben Eiter, welcher Staphylococcus albus enthielt. Röntgen: Linke Niere vergrössert, im Nierenbecken ein grosses Konkrement. Bei Urographie keine Aussonderung.

Operation: In einer ersten Sitzung wurde die Nephrostomie vorgenommen mit Entleerung von ea. 1 700 ccm dicken Eiters, in welchem Staphylococcus albus nachgewiesen wurde. In einer zweiten Sitzung wurde die Nephrektomie ausgeführt (Prof. HELLSTRÖM).

Makroskopischer Nierenbefund: Etwa kokosnussgrosse Niere mit grobbuckliger Oberfläche. Kapsel stark schwartig verdickt und mit dem Nierenparenchym verwachsen. Nierenbecken und Kelche stark erweitert. Im Nierenbecken ein Stein (ea. 3×3 cm). Am unteren Nierenpol ein kleinerer Verkalkungsherd im Parenchym. Dicke des Nierenparenchyms ea. 2 cm. Stellenweise im Nierenparenchym, jedoch hauptsächlich im Mark, finden sich zahlreiche, bis walnussgrosse, herdförmige, gelbweisse Ablagerungen von fettähnlicher Konsistenz.

Mikroskopischer Nierenbefund: Das Nierenparenchym ist praktisch vollständig von einem Granulationsgewebe ersetzt, in welchem sich lipoidreiche Xanthomzellen in grosser Menge finden. Die erhalten gebliebenen Glomeruli und Tubuli zeigen keine Verfettung. An den

Stellen der makroskopischen Herde besteht das Granulationsgewebe praktisch ausschliesslich aus Xanthomzellen mit sehr reichlicher, teilweise anisotroper Lipoidablagerung (Fig. 2). Das Granulationsgewebe greift auch auf die Kapsel über, welche stark schwielig verdickt ist. Nierenepithel gänzlich zerstört. Arterien und Arteriolen hochgradig degeneriert, ohne Lipoidablagerungen..

Fall 3. E. S. 28jährige Frau. *Klin. Diagnose:* Pyonephrosis dext. c. lithiasis.

Im Alter von 17 Jahren Krankenhausaufenthalt wegen Albuminurie + Hämaturie. Bei Entlassung aus dem Krankenhaus enthielt der Harn keine pathologischen Bestandteile. Hat jetzt seit etwa $\frac{1}{2}$ Jahre zeitweise einen diffusen, leichten Schmerz in der rechten Seite und im Kreuz. Vereinzelte akute Schmerzanfälle. Kein Fieber. Keine subjektiven Beschwerden seitens der Harnwege. Fühlt sich matt und hat im letzten Jahre 7 kg an Gewicht abgenommen. Bemerkte selbst eine druckempfindliche Geschwulst rechts im Bauche. — Am Orte der rechten Niere tastet man einen faustgrossen, stark druckempfindlichen Tumor mit grobbuckliger Oberfläche.

Im Harn finden sich massenhaft weisse Blutkörperchen, aber keine Bakterien. Katheterisierung des rechten Ureters entleert gelbgrünen Eiter, welcher keine Bakterien enthält. Bakterienkultur neg. Röntgen: Rechtseitiger abgeschlossener Pyonephrose mit grossen Verkalkungen und Gasbildung.

Operation: Nephrektomie (Prof. HELLSTRÖM).

Makroskopischer Nierenbefund: Niere kindkopfgross, mit der Umgebung fest verwachsen. An einzelnen Stellen sickert aus der Nierenoberfläche Eiter von koli-ähnlichem Geruch hervor. Nierenbecken und Kelche erweitert. Im Nierenbecken mehrere grössere und kleinere Steine. Im Mark mehrere walnussgrosse, gelbliche Herde.

Mikroskopischer Nierenbefund: Nierenparenchym nahezu vollständig zerstört. Nur wenige Glomeruli und Tubuli sind übrig geblieben; ihre Zellen enthalten feine Lipoidtropfen. Zahlreiche grössere und kleinere, teilweise zerfallende Abszesse in Rinde und Mark. An mehreren Stellen — hauptsächlich jedoch in der Innerzone der Rinde und im Mark — grosse Herde von Granulationsgewebe, welche nahezu gänzlich aus Xanthomzellen bestehen. Diese Herde sind von jungem, plasmazellen- und rundzellenhaltigem Granulationsgewebe umgeben. An der Grenze gegen das Nierenbecken geht das fibrös umgewandelte Nierengewebe in junges Granulationsgewebe der letzterwähnten Art über. Nierenbeckenwand stark chronisch entzündlich infiltriert und unregelmässig verdickt. Ihr Epithel vollständig zerstört und von Granulationsgewebe ersetzt, dicht infiltriert hauptsächlich von Plasmazellen, aber auch von Lympho- und Leukozyten.

In den drei hier beschriebenen Fällen zeigten die Nieren bei makroskopischer Untersuchung bis walnussgrosse Herde von gelblicher Farbe und fettartiger Konsistenz. Die meisten Herde lagen im Bereich des Nierenbeckens oder der Markzone.

In einem der Fälle wurde *Staphylococcus albus* im Eiter gefunden. In den anderen zwei Fällen liessen sich Bakterien weder direkt noch durch Züchtung nachweisen; aber in einem derselben hatte der Eiter starken sogen. Koligeruch. Der Fund im ersteren Falle stimmt gut überein mit der Angabe, dass Xanthomzellen bei Staphylokokken-Pyelitis auftreten können. Ob dagegen betreffs der Bakterienart im letztgenannten Falle ein Rückschluss erlaubt ist, bleibt ungewiss, da in dieser Hinsicht nur spärliche klinische Angaben zur Verfügung standen. Wie bereits erwähnt, sollen jedoch auch gewisse Koli-Arten bei den Pyelitiden vorkommen, wo sich Xanthomzellen finden.

Mikroskopisch zeigte sich in allen drei Fällen eine ausgedehnte Zerstörung des Nierenparenchyms. In den wenigen erhalten gebliebenen Glomeruli und Tubuli fanden sich stellenweise geringe Mengen feiner Lipoidtropfen in den Zellen. Den gleichen Befund boten auch die Wände der Kapillaren und Arteriolen, das interstitielle Bindegewebe und das Gewebe des Nierenbeckens, einschliesslich dessen Epithels.

Den makroskopischen Herden entsprach mikroskopisch ein Granulationsgewebe, welches grösstenteils aus Xanthomzellen mit reichlichen Mengen von Lipoidtropfen aufgebaut war. Die letzteren bestanden zum überwiegenden Teil aus einfach brechender Substanz. Doch kam auch doppelbrechende Substanz vor. Cholesterinkristalle wurden in keinem unserer Fälle gefunden.

Über die *Pathogenese* der Xanthomatose in den vorliegenden Fällen dürfte keine völlige Klarheit zu gewinnen sein. Ohne hier ausführlich auf diese sehr interessante Frage eingehen zu wollen, möchte ich doch einige der best annehmbaren Erklärungen anführen, welche hier in Betracht kommen.

Lipoidablagerungen in Form eines an Makrophagen reichen Granulationsgewebes können durch allgemeine oder lokale Faktoren oder durch Zusammenwirken beider Arten verursacht sein.

Unter den allgemeinen Ursachen, welche vor allem in Betracht kommen, seien folgende genannt:

1. Allgemeine Lipoidose derjenigen Art, welche Krankheiten wie Morbus Gaucher und Morbus Hand-Schüller-Christian hervorruft. 2. Allgemeine Lipoidose, wie sie z. B. bei Diabetes und in seltenen Fällen auch in der Schwangerschaft auftreten kann. Bei diesen Zuständen bilden sich Lipoidablagerungen vor allem im retikulo-endothelialen System. Es wurden jedoch hierbei Xanthomzellen auch in der Nachbarschaft von Abszessen und in

entzündlichem Granulationsgewebe gefunden. Das Primäre dürfte zweifellos eine allgemeine Störung des Lipoidstoffwechsels sein. Eine lokale Xanthomatose erfährt durch Hyperlipoidämie eine Zunahme, wie u. a. WEBER gezeigt hat.

An lokalen Ursachen scheinen hauptsächlich folgende in Betracht zu kommen:

1. Ausscheidung von Fett durch die Nieren (aus allgemeinen oder lokalen Ursachen) mit Rückresorption und Ablagerung in den Phagozyten.

2. Phagozytose von Fett, welches beim lokalen entzündlichen Gewebszerfall freigeworden ist, wofür letzterer bedingt sein kann durch allgemeine oder lokale Bakterien- oder Toxinwirkung, Erschwerung des Kreislaufs (vor allem Lymphstauung, LUBARSKY) o. dergl.

Welche der angeführten ätiologischen Faktoren die vorliegenden Fälle am besten zu erklären vermag, ist nicht ganz leicht zu beurteilen. Wenig wahrscheinlich dürfte die Annahme sein, es habe hier eine Form von allgemeiner Lipoidose vorgelegen. Die hierher gehörenden Krankheitsbilder sind so typisch und wohl charakterisiert, dass sie von der Erörterung ausgeschlossen werden können.

Allgemeine Xanthomatose ist mindestens in den Fällen 2 und 3 mit praktisch völliger Sicherheit auszuschliessen. Im Falle 1 traten zwar die Nierensymptome im Anschluss an eine Schwangerschaft auf; aber dieser dürfte wahrscheinlich keine Bedeutung für die Entstehung der Xanthomzelleninfiltrate zukommen. Mit Rücksicht auf das gewaltige Ausmass der Lipoidablagerungen ist diese Möglichkeit jedoch nicht gänzlich von der Hand zu weisen.

Lipurie dürfte unwahrscheinlich sein; für diese bestehen in unseren Fällen keine Anhaltspunkte.

Im Hinblick auf die stark ausgesprochenen lokalen Entzündungsvorgänge — im Falle 2 mit nachweisbaren Bakterien und im Falle 3 mit starkem sogen. Koli-Geruch — ist am wahrscheinlichsten die Erklärung, dass die hier vorliegenden Lipoiden infolge des starken Gewebsschadens aufgetreten sind, welcher mikroskopisch festzustellen war. Der Mechanismus im Einzelnen darf hier unerörtert bleiben. Der Hauptfaktor dürfte die durch Bakterien und Toxine hervorgerufene Gewebsschädigung sein, die zu einer lebhaften Phagozytose von Lipoiden führt.

Zusammenfassung.

Verf. beschreibt drei Fälle von Steinniere mit Pyonephrose. In zwei von den Fällen handelte es sich um 23—, bzw. 37jährige Frauen, im dritten um einen 56jährigen Mann. Die Operationspräparate zeigten in sämtlichen drei Fällen schwere pyelonephritische Veränderungen mit mächtiger Entwicklung eines lipoidreichen Granulationsgewebes, das Teilen des Hilus- und Nierengewebes eine undurchsichtige gelbliche Farbe verliehen hatte. Es wird für derartige Veränderungen die Bezeichnung Pyelonephritis xanthomatosa vorgeschlagen.

Summary.

The author describes three cases of stone kidney with pyonephrosis. Two of the cases concerned females of respectively 23 and 37 years of age, and the third was a 56 years old male. The operation preparations showed in all three cases serious pyelonephritic changes with development of a granulation tissue, rich on lipoids, which had given parts of the hilus and kidney tissues an opaque yellowish colour. The term Pyelonephritis xanthomatosa is suggested for such changes.

Résumé.

L'auteur décrit trois cas de rein calculeux avec pyonéphrose. Dans deux, il s'agissait de femmes de 23 et de 37 ans, dans le troisième, d'un homme de 56 ans. Les pièces opératoires montraient chaque fois de graves lésions pyélonéphrétiques avec un développement intense de tissu de granulation riche en lipoides, qui avait conféré à certaines parties du hile et du parenchyme rénal une couleur jaunâtre opaque. L'auteur propose pour des altérations de ce genre l'appellation de Pyélonéphrite xanthomatense.

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From Ludvika Hospital (Chief: M. D. HERMAN WAHREN.)

Arterio-mesenteric Obstruction.

By

HERMAN WAHREN.

Intestinal obstruction caused by the mesenteric pedicle has been recognized for a long time and many different opinions have been advanced on the subject. As early an author as ROKITANSKY dealt with it in his *Lehrbuch der pathologischen Anatomie* which appeared in 1863, and even so he mentions previous authors treating the subject.

The condition can be briefly described as follows: The mesenteric pedicle passes over the *pars ascendens duodeni*. The mesenteric vessels in particular exert a constricting pressure on the intestines, which effect is enhanced by a gravitation of the full small intestinal loops down towards the pelvis. This constriction of the duodenum is supposed to take place mainly between the *art. mesenterica superior* proceeding from the aorta and the posterior abdominal wall — i. e. the anterior side of the *vertebrae*.

There is extensive literature on this subject. A large number of earlier authors considered it likely that post-operative and peritonic vomiting is due to this mechanism. Older handbooks, such as WILMS, 1906, afford large space to the arteriomesenteric obstruction.

After 1920—1925, the subject is seldom mentioned in medical literature. Nevertheless, VON HABERER advocates the theory of arterio-mesenteric obstruction and its importance in a rather violent polemic against MELCHIOR. In 1923—1926, HALPERT published several works on arterio-mesenteric obstruction, considered mainly from a purely anatomical viewpoint. Sceptical voices were still to be heard, however. Thus S. R. and C. A. DRAGSTEDT, 1922, write: "Reasoning a priori, it seems incredible that the rela-

tion of the mesentery to the duodenum should leave such a small factor of safety that a mere gravitation of the small intestine into the pelvis, such as must occur in every individual when standing, could precipitate a life-endangering obstruction of the bowel." Similarly, ROBERTSON writes in 1925: "As time passes, I feel pretty confident that the superior mesenteric arteric pressure theory will fade until it disappears altogether from our horizon."

The increased scepticism with which the condition is regarded, and the accompanying fact that it is accorded less and less mention in medical literature, is beyond doubt connected with the development of roentgenology. The older literature was based mainly on anatomical observations and abstract argument, so that when X-ray methods subsequently made it possible to observe the motoric function of the intestinal canal, the conception of arterio-mesenteric obstruction could no longer be preserved.

There is of course every reason to be sceptical of the idea that the drag of the small intestinal should be able, via the mesentery, to exert any obturating effect on the duodenum. Notwithstanding this, the mesenteric root can act as an obturating intestinal obstruction, as the following case shows:

J. K., 52 years. Treated at the age of 26 for gastric complaint, type unknown. Since then he has been well till about a year ago, when he contracted gastric trouble, pains in the stomach after eating, and could not take meat in any form. He had lost much weight during the last few months. He had a sensation of the stomach rapidly becoming full at meals. Occasional vomiting.

Status: Subject showing considerable loss of flesh. Cor: 0. Pulm: 0. Abdomen: Upper part slightly distended. X-ray examination: Stomach fairly large, filling well. Duodenum very much distended. There is an obstruction level with the flex. duodenojejunalis, which the contrast passes only with difficulty. Strong peristalsis in the duodenum. The nature of the obstruction cannot be established by X-ray examination.

The X-ray findings suggest the presence of an intestinal obstruction, which is connected with the passage of the small intestinal mesentery over the pars ascendens duodeni. According to reports in the older literature, rest in bed alleviates the patient's distress in arterio-mesenteric obstruction. On this account, the present patient was put to bed and given many small meals. After 12 days, his condition was completely unchanged, however. A new X-ray examination showed the same picture as on the previous occasion.

Operation (the author): *Division of the pars descendens duodeni with reunion of the loops in front of the radix mesenterii.* Incision in the median line above the navel. The stomach was somewhat ectatic but otherwise normal. The visible parts of the duodenum were consider-



WAHREN: Arterio-mesenteric Obstruction.

ably dilated and had thickened walls. The jejunal loops had collapsed. The mesenteric root plainly formed the dividing line between the dilated duodenum and the collapsed intestinal loops. A closer study of the conditions there showed that the intestinal portion under the mesenteric root was lying pressed against the posterior abdominal wall. However, this compression was not caused by the arteria mesenterialis superior, at any rate not directly so, but by fibrous strands of connective tissue in the direction of the mesenteric pedicle.

Originally, a duodeno-jejunostomy had been intended, but the free part of the pars inferior horizontalis was too short to make an anastomosis of this kind possible. The duodenum was therefore divided and the loops reunited in front of the radix mesenterii. After the operation the patient received a blood transfusion.

The intestinal passage did not function normally after the operation. On the second day a duodenal tube had to be introduced. The fluid balance could be preserved satisfactory by intravenous infusion. The protein level in the serum decreased; blood and plasma transfusions were therefore given. As the patient's condition did not improve and there were certain reasons for assuming a mechanical obstruction of the bowel, relaparotomy was performed 8 days later with an incision parallel to the left costal arch. It was then found that the first free jejunal loop lay doubled over, fixed against the anastomosis place, where a few small fibrous deposits indicated local peritonitis. The loop was released, the sutures inspected, and a posterior retrocolic gastroenterostomy performed. After-course normal.

Two months after the operation, X-ray examination still showed an extended emptying of the stomach. The contrast mass passed through both the duodenum and the gastroenterostomy. 7 months after the operation the patient is feeling well, has increased 13 kilos in weight and is working whole-time.

This case is interesting from several points of view. Very few cases of arterio-mesenteric obstruction established by X-ray examination are described. As mentioned in the operation report, the arteria mesenterica superior did not in itself seem to exert any constrictive action; this compression was due rather to the strong fixation of the ascending portion of the duodenum against the posterior abdominal wall by the fibrous connective tissue in the mesenteric pedicle. The method of dividing the duodenum and rejoining the loop in front of the mesenteric root was suggested by ROBERTSON, but I have not found any evidence in current medical literature that this operation has been used. It is unfortunately impossible to assess the immediate effect of this operation, on account of the mentioned complication caused by the kinking of the intestine. When possible, it is unquestionably better to make an anastomosis between duodenum and jejunum.

After the operation, a typical condition of so-called gastric ileus developed. It is quite obvious, that in this case a mechanical obstruction caused by the kinking of the first jejunal loop has caused the process. This is a relatively rare cause of gastric ileus. In his comprehensive monograph from 1935, PERMAN fully deals with gastric ileus and comes to the conclusion that this complaint is due to a combination of mechanical and dynamic forces. Attention should, however, in this connection also be given to the secretory conditions after the operation. We know that the quantity of fluid passing through the intestinal canal every 24 hours, corresponds to more than double the quantity of blood. It is obvious, that disturbances in this secretion must affect post-operative intestinal conditions. A big part of this secretion comes from the liver and the other large glands, but an appreciable amount must also come from the gastric mucosa.

During the last 5 years, I have made close study of post-operative conditions after gastric resection. At first, I made "antrum resections", using the BILLROTH I method. In 3 of 13 operations, considerable disturbances in the form of intense gastric ileus set in. One patient died. As I was not satisfied with the results, I changed to high resections, more than three years ago. These were performed mainly according to a method developed by LAHEY and MARSHALL, leaving only 20—30 % of the stomach, and using gastrojejunal antecolic anastomosis without enteroanastomosis. 63 operations have been carried out according to this method without mortality. In no case has gastric ileus been observed and only in a very few cases was a duodenal tube necessary after operation. One may assume that this uneventful after-course is a result of large resections of the secreting gastric mucosa.

Summary. .

One case found by X-ray examination to be arterio-mesenteric obstruction, and verified by operation, is described.

Zusammenfassung.

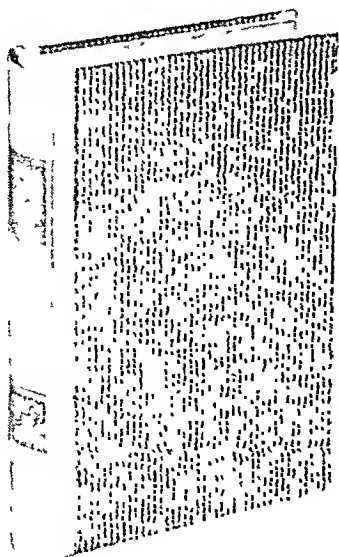
Beschreibung eines Falles von arteriomesenterialer Verstopfung, durch Röntgen gefunden und mit Operation verifiziert.

Résumé.

Description d'un cas d'obstruction artério-mésentérique, localisée par iöntgen et verifiée par opération.

Literature.

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Benign Bronchial Adenomas.

By

J. ENGELBRETH-HOLM.

Since GEIPEL (1931) as the first called attention to a special tumour type among the benign bronchial new growths describing it as a basal cell carcinoma — a term that has later been changed into “adenoma” — these tumours have been the topic of unremitting discussion.

Introduction of the bronchoscope as a routine remedy to the clinician further increased the interest in this subject, disclosing soon these tumours to be of a far greater incidence than hitherto believed.

Certain features of their pathology are, however, still obscure: their exact origin and their assumed tendency to malignant change — the latter of which being of great importance to the choice of treatment — are problems subjected to constant debate. No more has their relation to or distinction from other tumours been definitely elucidated. It is still a question whether we must regard the “benign bronchial adenoma” as an entity or as a complex of various mutually diverging tumour types.

According to PATERSON (1936) the incidence of the bronchial adenoma is about 50 per cent of that of all benign bronchial tumours, a fact which has been confirmed by POLLACK, COHEN & GUASSI (1938) who from the literature collected 104 cases of bronchial tumours, 51 of which were found to be adenomas. The tumour type next to this was the “inflammatory tumour” including 23 cases. The remaining tumours were fibromas (8), chondromas (6), lipomas (5) and mixed tumours e.g. fibrolipoma, myxochondroma, ossifying chondroma, and finally, a few cases of myoma, osteoma, lymphoma a. o.

In 1932, JACKSON & JACKSON asserted that the incidence of the inflammatory tumours (polyps and granulomas) is surpassing that of any other tumour in the bronchus. This, however, scarcely holds true, though "tumours" due to inflammation are found to be decidedly more frequent than previously maintained. (PERONI (1934) and other authors have made further studies into this problem.)

The *incidence* of the bronchial adenoma is about 6 per cent. of that of the bronchial carcinoma (MORLOCK and SCOTT PINCHINI, 1935 (nine out of fifty), KRAMER and SOM, 1935 (23 adenomas and 332 carcinomas), WESTERMARK, 1943 (11 benign tumours and 180 carcinomas).

In contradistinction from the carcinoma, the bronchial adenoma is found to occur most frequently in women (60 per cent.) and, in fact, chiefly before the age of forty (60 per cent. between 20 and 40) a period in which pulmonary carcinoma will be found in ten per cent. only (BRUNN and GOLDMAN, 1941, KRAMER and SOM, 1935). Also their *clinical course* is widely varying from that of the carcinoma involving, as a rule, several years. Among the cases reported by KRAMER and SOM 15 lasted more than 3 years, 8 more than 6 years. In a material including 19 cases BRUNN and GOLDMAN found 7 lasting more than 10 years and 16 lasting more than six years. In one case, the symptoms were persistent even for 30 years. But, as a rule, pulmonary affections due to occlusion of the bronchial lumen will convey death earlier, if the adenoma is left untreated.

The *histological* structure of these adenomas has been subjected to repeated and detailed reviewing (HAMPERL 1937, BRUNN and GOLDMAN 1941). It may vary from case to case and even from area to area within the same tumour.

The adenoma generally appears as a small, smooth, bright red submucous, nodule about 1 to 3 cm. in diameter, arising from the bronchial wall. It is worthy of notice that they are always located in a main bronchus or where the stem bronchus is branching to a lobe, in no case bronchial adenoma has been seen more peripherically. BRUNN and GOLDMAN (1941) in 90 per cent. found the adenomas expanding outside the bronchus, but it must be emphasized that the extrabronchial portion which is often the bigger one is encapsulated too.

Towards the lumen the adenoma is lined by an epithelium revealing most frequently signs of metaplasia into a stratified

squamous epithelium. Directly beneath this, there is a fibrous capsule in which differentiation of bone tissue may sometimes take place. Next to this, the true tumour will be found displaying no connexion whatever with the lining epithelium. It is composed of closely packed small cubic to cylindric deeply staining epithelial cells of a uniform appearance and arranged in strands and nests tending at times to acinous arrangement. There is generally marked invasive growth in the stroma, at times even in the lymph vessels, a remarkable fact which has more than once impelled the histologist to make the diagnosis of a carcinoma upon this clinically benign tumour displaying as a rule no signs of metastases and no tendency to recurrence. At times the tumour cell will present various stages of differentiation into mucous glandular cells tending to arrange themselves as acini. The histological pattern may sometimes simulate that of a hypernephroma and be mistaken for it (WOMACK and GRAHAM 1938). In our material too (Case 7 and 10) this diagnosis was erroneously made, in fact no astonishing mistake as a remarkable abundance of blood vessels and capillaries in the stroma is another characteristic feature of these tumours. In 2 out of 9 cases of bronchial adenoma HAMPERL describes "oncoocytes" (i.e. big light eosinophilic cells with an abundant cytoplasm).

Some cases may display a picture closely resembling that of the so-called mixed tumour of the salivary gland with areas of cylindromatous pattern but, as a rule, without differentiation of cartilage tissue. Only BRUNN and GOLDMAN, WOMACK and GRAHAM (two cases) have observed cartilage in bronchial adenomas; in all other reports cartilage is not mentioned. In some adenomas it will appear as discrete isles of hyaline cartilage in the stroma disclosing no signs of gradual transformation from epithelial cells into mesenchymal and chondroid cells which is otherwise a most typical feature of the mixed salivary tumours.

The marked vascularity that is often encountered in the bronchial adenoma easily explains their tendency to hemorrhages as hemoptysis. It is a most interesting statement — although not yet sufficiently elucidated — that these tumours may give rise to bleedings synchronously with the menstrual period. According to BRUNN and GOLDMAN such bleedings are of no rare occurrence, a fact that has been confirmed by TURNER (1933). JACKSON and KONZELMAN (1937) have further described two of such cases.

How to explain the complexity of different histological pictures ("cylindroma", "adenoma", "carcinoid", etc.) — whether in fact they are one and the same tumour or mutually diverging tumour types with only some features in common e.g. localization and clinical course, remains a problem still open to discussion. A definite solution always must depend upon a thorough knowledge of those cells and tissues from which these tumours take their origin.

As previously mentioned GEIPEL has described his cases as basal cell carcinomas, a designation which has later been dropped. Another theory of some interest — although probably wrong — is advocating their origin from embryonic buds viz. non-developed foci of lung anlagen. HECK (1916) advanced this theory basing upon 2 cases which he took for primary polypoid bronchial carcinomas. WESLER and RABIN adopted this "anlage"-theory finding that the histological picture was closely resembling that of fetal lung. WOMACK and GRAHAM further consolidated this view proposing to these tumours the name of "mixed tumours of the lung", recognizing that all benign bronchial tumours viz. "adenoma, endothelioma, chondroma, osteoma, fibroma, myoma, lipoma, angioma and carcinoid" are belonging to the same well defined group comparable by analogy to the mixed tumours of the salivary gland. They further maintain that in spite of the predominating epithelial elements offering so close resemblance to fetal lung, elements from two germinal layers, i.e. the entoderm and the mesoderm will as a rule be traceable. In 2 out of their 11 tumours they found differentiation of isles of cartilage in the stroma only, and as mentioned above, it was obviously due to no epithelial differentiation as is the case with the mixed tumours of the salivary gland. The fact, however, that these tumours are exclusively found in the main bronchus may perhaps add weight to this assumption.

Other authors are of opinion that bronchial adenomas must be distinguished from chondroma, myxoma, etc. the latter being regarded as hamartomas i.e. failures of normal development. Joining the view of LINDGREN (1943) we may thus make a distinction between two groups of benign new growths of the bronchus: the bronchioma and the adenoma. According to some writers, the adenoma ought perhaps to be again divided into cylindroma and adenoma of the salivary gland type.

As early as in 1882, MÜLLER described a cylindroma in the left

main bronchus. Basing on the morphological picture HAMPERL makes a sharp distinction between cylindroma (2 cases) and "carcinoids" (7 cases). KRAMER and SOM, likewise, will classify the cylindroma as a special type. They adopt the term: *cylindroma* in the sense of BILLROTH (1859) describing a series of these tumours arising from the upper respiratory tract. In 3 cases tumour was located in the main bronchi. In concluding they write: "The tumour grossly resembles benign adenoma, from which it can be differentiated only microscopically".

This question will be further discussed on p. 400 ff.

It is now generally acknowledged that the bronchial adenomas have their origin in the mucous glands of the bronchial wall (BERGER 1922, BROCK 1938, BRUNN and GOLDMAN 1941, FRIED 1934, HAMPERL 1937, HEINE 1927, KRAMER and SOM 1935, LAFF 1940, LINDGREN 1943 a. o.). Kramer even ascribes their origin to the ductuli and not to the acini, and actually it cannot be denied that these tumour cells bear a closer resemblance to the ductuli cells than to those of the acini.

This assumption in part is based on the pure morphological resemblance between the tumour cells and the glandular cells and the ductuli cells respectively, and in part on a conclusion by analogy that tumours so closely resembling the mixed salivary tumours must arise from glandular elements in the bronchial wall related to similar elements in the salivary glands. The fact that the tumours are lined by an intact epithelium and even separated from this epithelium by a fibrous capsule seems to support this assumption.

According to LAFF (1940) these tumours are only found in those parts of the bronchi which contain the glands in question. In his opinion, bronchi of less than 1 cm. in diameter will include no mucous gland. This, in fact, is wrong since glandular elements are actually present as far out into the bronchial tree as the cartilage extends i.e. until a diameter of 1 mm. It is thus rather peculiar that these tumours occur in the main bronchus only.

Another fundamental question subjected to vivid discussion implies the tendency of these bronchial adenomas to undergo malignant transformation. As to this point all kinds of views have been advanced, from a pure denying of the said potency to an assertion of their potential malignancy (e.g. LAFF), and even to a classification of them as adenocarcinomas of grade I (MALKWITZ 1922, MOERSCH 1935, MILLER 1935).

The solution of this problem is, however, no easy task. The clinical course is suggestive of benignity, whereas the histological picture is rather confusing. The tumour cells are displaying neither polymorphous nor atypical features, nor mitotic figures, and still a marked invasive growth — though denied by KRAMER & SOM — is an outstanding characteristic in the histological picture. KERNAN (1935) reports of a tumour cells in a blood vessel (1 case), and HECK (1916), KRAMER (1930) and ZAMORA & SCHUSTER (1937) have described cases in which metastases had developed. The rare accidental discovery of bronchial adenomas at autopsy should be indicative of their malignant potency and their corresponding fatal course (WOMACK).

The strange contrast between the histological picture showing invasive growth and — on the other hand — the morphological benignity of the cells explaining the extremely slow clinical course is a fact now generally agreed on, but there remains a problem as yet unsolved whether these tumours may develop into carcinomas being thus rightly regarded as potentially malignant with claim of adequate treatment.

A series of cases which I have had the benefit of observing is displaying certain features that may perhaps elucidate some of these obscure problems, especially with respect to the origin of the bronchial adenoma and its presumed potential malignancy.

*Case 1.*¹ Man, aged 43 (Radiumst. 27061). For some years dyspnoea and cough with at times hemorrhagic expectoration. Frequent fever periods. After repeated attacks of pneumonia, an endobronchial tumour is diagnosed by *bronchoscopy* in a local hospital, being located in the right bronchus $1\frac{1}{2}$ cm. from carina.

Microscopical examination here disclosing a "carcinoma", he was transferred to the Radiumstation where the correct diagnosis was made and the tumour removed by *bronchoscopy*. Subsequent electrocoagulation of the tumour site (HUSFELDT). One year later no symptoms were present.

Microscopical examination (1504/42, 1748/42): The smooth tumour surface is covered with a stratified squamous epithelium without keratinization. Beneath this a fibrous capsule is seen

¹ I want to express my thanks to the surgeons-in-chief, prof. E. DAHL-IVERSEN, M. D. and E. HUSFELDT, M. D. Rigshospitalet, Copenhagen, and to the physicians-in-chief TAGE KJÆR M. D. Øresundshospitalet and JENS NIELSEN, Radiumstationen, Copenhagen, for kindly permitting me to dispose of the case histories in question. I am also indebted to prosecutor Sv. PETRI, M. D. Kommunehospitalet and to FRIDTJOF BANG, M. D. Radiumstationen, Copenhagen, for placing at my disposal microscopical specimens.

separating the lining epithelium from the tumour tissue proper (fig. 1). Tumour is composed of solid nests and anastomosing strands of small cubical epithelial cells with globoid or ovoid nuclei of nearly uniform appearance. There are no mitotic figures. The chromatin presents a fine meshwork. The nuclei contain one or two small nucleoli.

In some areas tumour cells of a nearly cylindric shape are bordering small cavities. Staining with muci-carminé is negative. In other places, the tumour cells are encompassing bigger cavities filled with blood (fig. 2). In a rather scanty stroma dilated capillaries are predominating. Neither cartilage nor bone tissue is seen. There is invasive growth in the capsule.

Histological diagnosis: Bronchial adenoma (of solid structure, with traces of glandular elements. No signs of secretion).

Case 2. Man aged 58 (The University Institute of Pathological anatomy 76/43). For a couple of years prior to admission the patient has been treated for an exfoliative universal erythrodermia. He contracts a pneumonia and dies. *Autopsy* reveals in the right main bronchus, directly beneath carina, an oblong smooth tumour measuring 4 by 2 cm (fig. 3). Tumour is occluding the bronchus totally. Further autopsy findings were: Chronic bronchitis, Atelectasis of the right lower pulmonary lobe, Chronic pyelonephritis, Nephrolithiasis, Ureterolithiasis, Hydronephrosis.

Microscopical examination (625/43): Tumour is displaying a most varying structure throughout. Beneath the smooth surface lined by a stratified squamous epithelium the usual fibrous capsule is seen. In some areas of the under-lying tumour solid isles and strands of closely packed small epithelial cells are found with relatively big nuclei presenting a uniform appearance. In other areas traces of glandular structures are found as small tubules and acini with no signs of secretion. In other places spherical sharply outlined cavities surrounded by more flat cells are showing a somewhat reticular arrangement. These cavities are filled with a fibrillous poorly staining substance or with homogenous, collagenous and hyaline masses suggesting the pattern of a cylindroma. These areas are rather sharply demarcated from those previously described (fig. 4). The stroma is abundant, fibrillary to fibrous, displaying transition from ordinary connective tissue into the cylindromatous masses dispersed among the tumour cells. In some areas the tumour cells arranged as delicate walls are surrounding big irregular cavities crammed with blood. Neither

mucoid nor chondroid stroma is present, no more than bone tissue. There is marked invasive growth in the stroma. In the neighbourhood of the tumour perineural sheaths of several nerve stems are solidly blocked by tumour cells (fig. 5).

Histological diagnosis: Bronchial adenoma displaying cylindromatous areas and marked invasive growth.

Case 3. Woman, aged 40 (Radiumst. 24987, previously published by HUSFELDT 1942 (Case III)).

During ten years cough and expectoration, partly hemorrhagic. Repeated attacks of pleuritis. *Bronchography* shows perfect filling of the right upper lobe, but beneath this a blocking of the main bronchus. Solid density of the middle and lower lobe. Slight pneumothorax with some atelectasis of the upper lobe. *Bronchoscopy* reveals a tumour in the right main bronchus. There are secondary pulmonary changes necessitating lobectomy of the middle and lower lobes. Pneumonectomy is performed (HUSFELDT), and the patient makes a complete recovery. In the removed lung (fig. 6) the main bronchus appears to contain a smooth, rather firm globoid whitish tumour, about 2 by 3 cm, in diameter, occasioning a total occlusion of the bronchus. No signs of metastases.

Microscopical examination (2908/41, 3213/41): A fibrous capsule with an epithelium showing signs of squamous metaplasia is covering the surface of the tumour which appears quite uniform throughout all parts. It is composed of solid thick anastomosing cords of quite uniform cubical epithelial cells with globoid nuclei (fig. 7). Mitotic figures are absent. There are wide-spread traces of glandular structure, the cells tending to arrange themselves as acini. A fibrillous connective tissue encompasses the cell strands. No signs of secretion. Next to the bronchial cartilage in the connective tissue, at the base of the tumour, isles of bone tissue are seen the marrow spaces of which are filled up by solid tumour masses (fig. 8). There is pronounced invasive growth, and the tumour has broken through the capsule extending as far as to a neighbouring lymph node. In a corner of the tumour small remainders of bronchial glandular elements are seen with intact mucinous acini. In some of these, the epithelium is seen gradually changing from cylindrical mucous cells into small cubical uniform cells displaying every feature of the surrounding tumour cells and encompassing the rest of the glandular elements as solid strands (fig. 9).

Histological diagnosis: Solid bronchial adenoma with invasive growth.

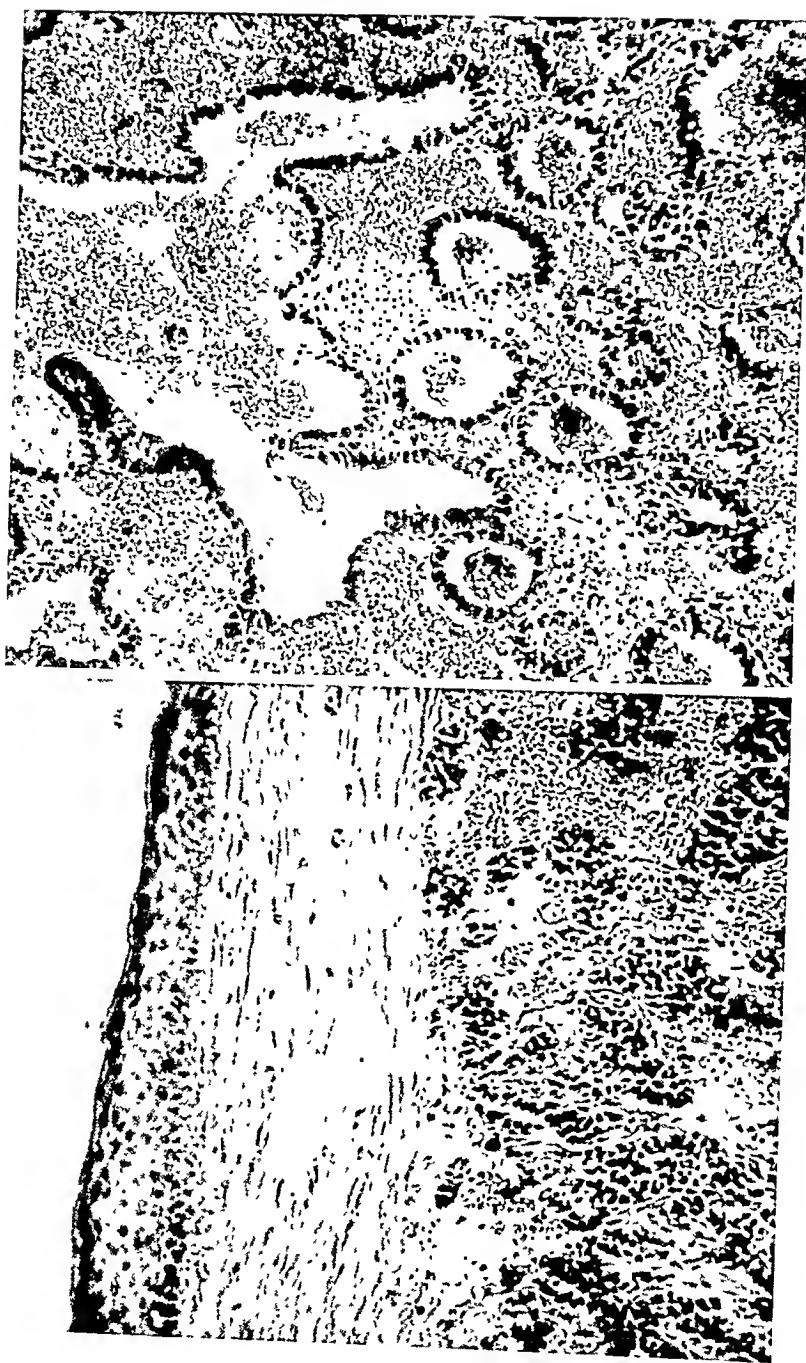


Fig. 1.

Fig. 2.

Fig. 1. Case 1. $\times 200$. Surface of tumour with covering stratified squamous epithelium and fibrous capsule. —
 Fig. 2. Case 1. $\times 200$. Part of tumour showing angiomatoid structure.

All the slides used for microphotograms were stained with VAN GIESON-HANSEN stain.



Fig. 5. Nerves from the tissue
Case 2. $\times 150$.



Fig. 4.

Fig. 4. Case 2. $\times 200$. Cylindromatous part of tumour. — Fig. 5. Case 2. $\times 150$. Nerves from the tissue
surrounding the bronchial tumour. Intense invasion of tumour cells filling all the lymph spaces.



Fig. 3.

Fig. 3. Case 2. Bronchial tumour.

Fig. 6.

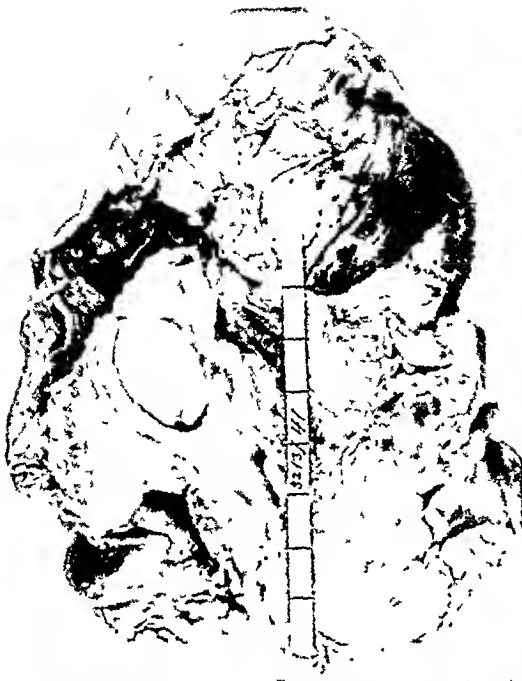


Fig. 7.

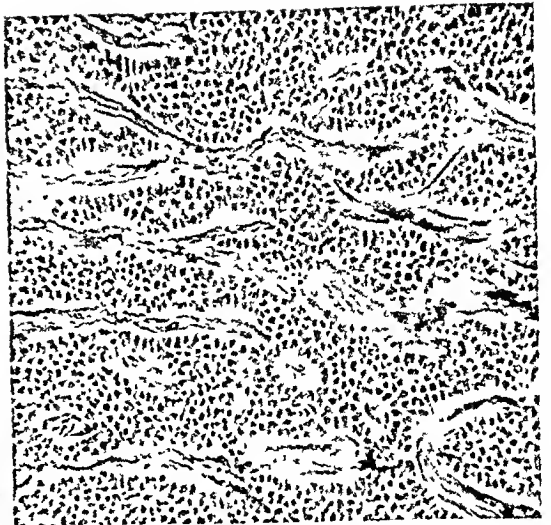


Fig. 9.

Fig. 8.

Fig. 6. Case 3. Smooth, round bronchial adenoma blocking the main bronchus.

Fig. 7. Case 3. $\times 200$. Solid trabecular strands of uniform tumour cells without mitotic figures.

Fig. 8. Case 3. $\times 200$. Formation of bone in the fibrous capsule (to the right). The tumour tissue fills up all the "marrow spaces".

Fig. 9. Case 3. $\times 150$. Small ducts of bronchial glands lying in the middle of the bronchial adenoma. Gradual transformation from cylindric cells filled with secretion into small dark cells similar to the surrounding tumour cells.

Fig. 10.

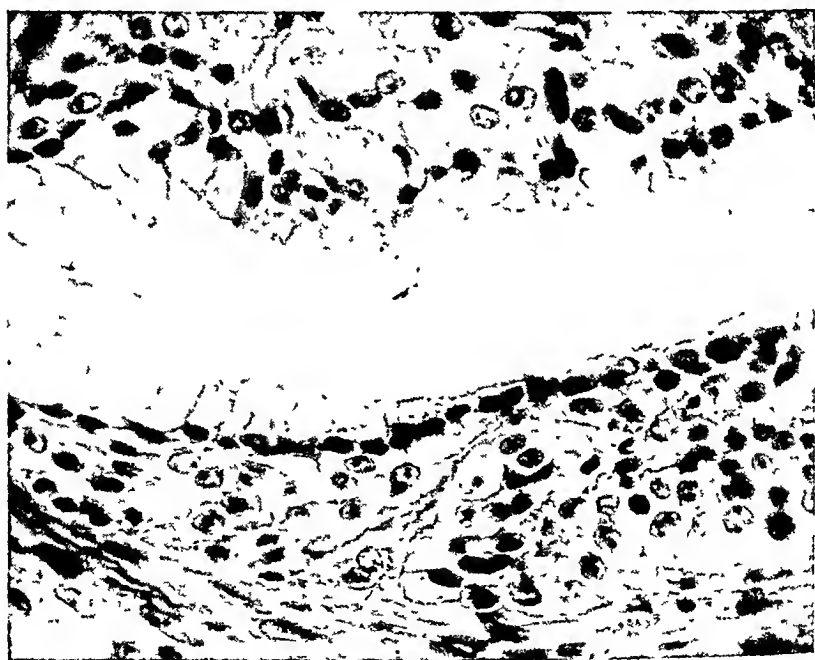


Fig. 11.

Fig. 10. Case 4. $\times 150$. Distended part of mucous gland with mantles of cells resembling the tumour cells beneath the epithelium. To the right tumour cells with squamous metaplasia.

Fig. 11. Case 4. $\times 450$. Part of fig. 10 showing the tumour-like cells outside the normal acinus the cells of which towards the right end of the lumen are flattening, suggesting transformation into tumour cells.

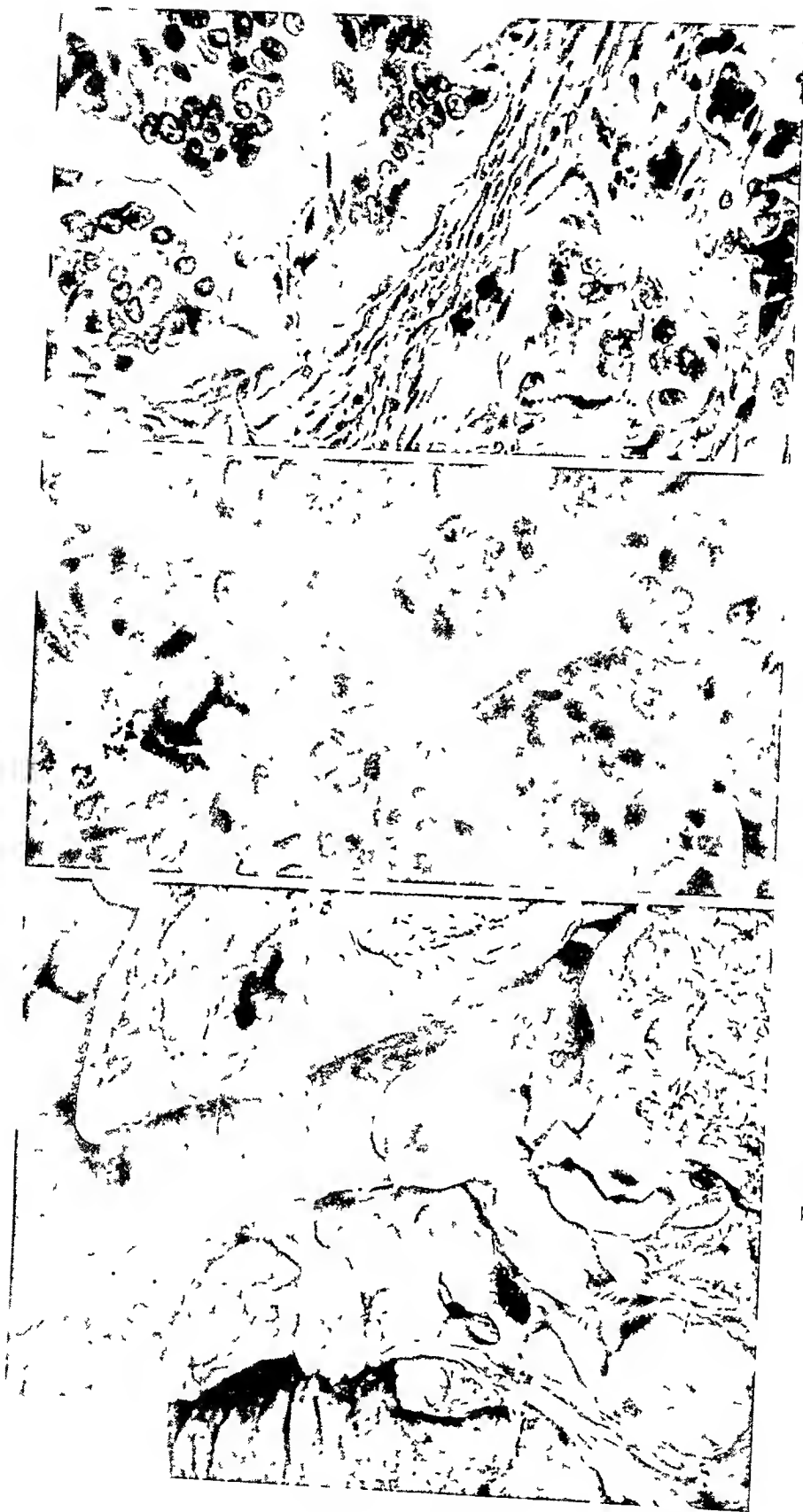


Fig. 12.

Fig. 13.

Fig. 14.

Fig. 12. Case 5. Big bronchial adenoma developing in the left upper bronchus and protruding into the main bronchus which is completely blocked by the enlarged hammer-like end of the tumour. Downwards to the left a roundish chondroma is seen. — Fig. 13. Case 5. $\times 450$. Section of tumour showing polymorphous tumour cells and a big tripolar mitosis. — Fig. 14. Case 5. $\times 300$. As fig. 13. Several mitoses, polymorphous cells and invasive growth in the stroma.

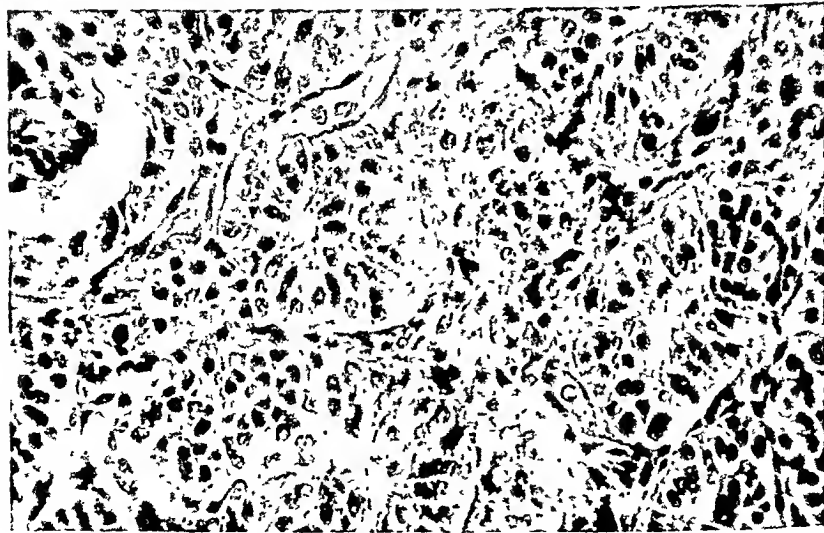


Fig. 15.

Fig. 15. Case 6. $\times 300$. Bronchial adenoma with gland-like arrangement. No signs of secretion. — Fig. 16. Case 7. $\times 200$. Hypernephroma-like bronchial adenoma. Among the clear cells the cytoplasm of which is filled with a watery secretion (staining for mucins negative) small isles of dark cells are seen resembling those of ordinary bronchial adenoma. — Fig. 17. Case 8. $\times 150$. Bronchial adenoma displaying a massive penetration of the capsule, the tumour tissue invading a neighbouring lymph node.

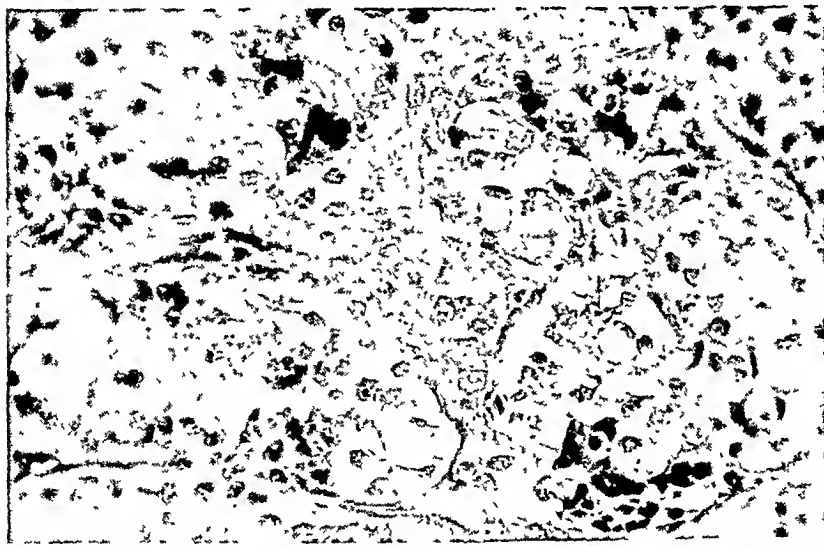


Fig. 16.



Fig. 17.



Fig. 18.

Fig. 18. Case 10. $\times 200$. Recurring bronchial adenoma 3 years after removal. Diffuse infiltration of tumour cells beneath the normal bronchial mucosa. No fibrous capsule, no metaplasia of surface epithelium.
 — Fig. 19. Case 11. $\times 150$. Distended bronchial gland filled with mucous secretion lying in an ordinary bronchial adenoma.



Fig. 19.

Fig. 20.

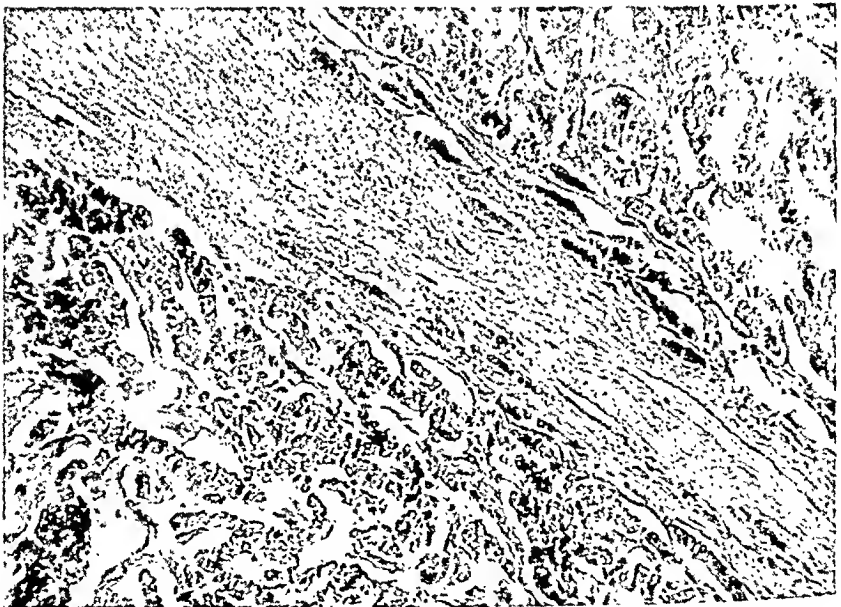


Fig. 21.

Fig. 20. Case 12. Extirpated pulmonary lobe showing a big smooth adenoma located in a dilated thin-walled bronchus.

Fig. 21. Case 12. $\times 200$. Section of same tumour with invasive growth in the stroma.

Case 4 (previously published by HUSFELDT, Case II). Woman, aged 22. Her chief complaint has been cough and fever during the last year. After an attack of fever with chills and pain in the chest, *bronchoscopy* is made: 3 cm. down the left main bronchus a greyish-red tumour is seen occluding totally the bronchial lumen. Its surface is smooth, some furrows and fissures excepted. *Roentgen examination* reveals a block in the main bronchus, about 3 cm. from bifurcation. A biopsy is made. After insertion of radon seeds, the patient makes a complete recovery.

Microscopical examination (Kommunehospital, Path. Institute. 1655/40):

In the small pieces of biopsy material no surface of the tumour is discernible. Tumour is composed of solid epithelial elements displaying in some areas a cylindromatous, in other places an adenomatous pattern. The cells are quite uniform throughout, small and cubical. There are signs of secretion with strong mucous stain here and there. In some areas, the normal bronchial glandular tissue is presenting strange pictures: the terminal portions being dilated (due to a stasis of secretion). Under the intact mucous glandular cells there are layers of small epithelial cells presenting exactly the same appearance as the cells in the tumour tissue proper. Morphologically it is impossible to make any distinction between these two kinds of cells (fig. 10, 11).

There is a striking resemblance between this picture and that met with in uterine cervical glands exposed to the effect of estrin: a layer of cylindric cells resting upon one or several layers of less differentiated epithelial cells. In addition, in some places the epithelium is changing into stratified squamous epithelium.

Histological diagnosis: Solid and adenomatous bronchial adenoma. Change of normal bronchial glandular tissue into tumour tissue.

Case 5. Man, aged 72 (The University Institute of Pathological anatomy. 440/41).

For some months increasing dyspnoea and fatigue.

Roentgen examination reveals a tumour in the left hilus occluding the left main bronchus. A pneumonia is developing and the patient dies.

Autopsy: In the left bronchus, about 4 cm. from carina, a smooth ovoid tumour measuring 3 by $2\frac{1}{2}$ by 2 cm., is occluding the lumen totally. From the side of this oblong tumour a thick pedicle protrudes into the upper lobe bronchus to which it is attached. The tumour, thus, resembles a hammer, the head of which is in the main bronchus, the short handle in the upper lobe branch. The bronchial lumina are filled with pus. The lymph nodes along the left side of trachea are enlarged. In the middle of the left upper lobe a globoid, sharply outlined cartilaginous tumour is seen, measuring about $2\frac{1}{2}$ cm., and revealing

no connexion with the bronchial tumour (fig. 12). Further autopsy findings are: Numerous purulent pneumonic foci in the atelectatic lung tissue, Chronic nephritis, Hypertrophica of the heart, Atherosclerosis of aorta with parietal thrombosis, Universal stasis.

Microscopical examination (The University Institute of Pathological Anatomy 1940/41): Tumour consists of solid epithelial masses lying in a fairly abundant fibrillary stroma. The cells are of the same type as those of solid bronchial adenomas, but less uniform in shape and size. They contain a number of, in part, atypical mitoses (fig. 13) and there is strongly pronounced invasive growth (fig. 14).

Quite obviously tumour is a bronchial adenoma but it is presenting incontestable malignant features. The pulmonary chondroma found in the neighbourhood of the tumour, is presenting no special features being composed of normal hyaline cartilage sharply outlined from the surrounding tissue.

No metastases in lung or lymph nodes.

Histological diagnosis: Malignant bronchial adenoma. Pulmonary chondroma.

Case 6. Man, aged 42 (Radiumst. 29279). During 3 years repeated attacks of bronchitis causing severe coughing and profuse expectoration.

There is a pronounced dyspnoe and fatigue with additional hemoptysis for the last month. *Roentgen examination* discloses a solid density of the whole left lung field. Trachea and heart are dislocated 3 cm to the left. *Bronchography* shows a total occlusion of the left main bronchus. At *bronchoscopy* an obstructive tumour is discovered in the left main bronchus, 2 cm. from carina. It is irregularly shaped with a lobated reddish surface bleeding easily. After repeated insertion of radon seeds tumour within six months is reduced to half its size.

Microscopical examination (biopsy material, no. 2416/43): Tumour is composed of the usual small uniform epithelial cells lying as solid nests in a scanty stroma of connective tissue. In several areas the cells are tending towards formation of glandular ducts revealing, however, no signs of secretion (fig. 15). Numerous blood-filled capillaries. No mitotic figures.

Histological diagnosis: Solid and adenomatous bronchial adenoma.

Case 7. Woman, aged 17 (The Rigshospital, dept. C. 4/43). During six months fatigue, cough and stitching pain in her right side. Slight expectoration. *Roentgen examination* discloses a solid density in the lower third of her right lung, complete occlusion beneath the branching of the upper lobe bronchus. In the lower lobe wide-spread bronchiectases. *Bronchoscopy* shows, 3—4 cm. down the right main bronchus, a

smooth tumour occluding totally the middle and lower lobe bronchi. It is removed by bronchoscope in four séances. Subsequent electrocoagulation of the tumour site (HUSFELDT).

Microscopical examination (The University Institute of Pathological Anatomy. 277/43, 401/43): Tumour is composed of solid isles of epithelial cells lying close together in a scanty stroma. The cells, for the most part, are rather big and bright with a strongly vacuolized cytoplasm. The histological picture is suggestive of a hypernephroma, a diagnosis which was erroneously made. The cell nuclei are rather small, deeply staining and centrally placed. There are, besides, some groups of smaller dark cells displaying the usual picture characteristic of a bronchial adenoma (fig. 16). Staining with mucicarmine is slightly positive. Mitotic figures are not demonstrated and the blood vessels are few in number.

Histological diagnosis: Bronchial adenoma of a solid type, with secretion.

Case 8. Woman, aged 16. (The Øresundshospital, 1166/43, published by KJÆR & PETERSEN, Case 2.) One year prior to admission she had a sudden attack of chills and high fever with pain in her left chest. After repeated fever attacks during some months there is complete dullness of the left pulmonary field. She is losing in weight, anemia has developed and on admission she is rather exhausted.

In the sputum tumour cells of the anaplastic carcinoma type were found.

Bronchoscopy shows 2—3 cm. down the left main bronchus a greyish-red obturating tumour from which several pieces are gradually removed. Tumour then appears to arise from the upper lobe bronchus, expanding into the main bronchus. Pneumonectomy is performed in two séances (KJÆR) after which complete recovery.

Gross examining of the left lung: The lung is small, atelectatic, showing on section a tumour, about 10 to 11 cm, including the upper lobe bronchus. Tumour is penetrating the bronchial wall displacing the tissue of the upper lobe. On section tumour presents a uniform appearance, greyish-white and firm, somewhat brittle of consistence.

Microscopical examination (The pathol. Institute of the Kommunehospital 76/42, 128/42): The tumour is composed of solid isles of closely packed small epithelial cells separated from one another by a scanty rather vascular stroma, the structure of which is uniform throughout the tumour. The cells are remarkably varying in shape, being oblong, angular, globoid or cubical alternately. The polymorphous picture of the nuclei is still more pronounced and in some places suggestive of malignancy although mitotic figures are absent. Several nuclei contain big nucleoli.

There is marked invasive growth, tumour has broken through the capsule invading as a solid tumour mass a regional lymph node (fig. 17).

Histological diagnosis: Solid bronchial adenoma with polymorphous and atypical cells and invasive growth.

Case 9. Man, aged 49. (The Rigshospital Dept. R. 172/43.) During 6 months persistent dyspnoe and loss of weight, annoying cough with expectoration. *Bronchoscopy* reveals a tumour mass invading the lumen directly beneath carina, narrowing, the right main bronchus into a fine split. Biopsy is made. *Roentgen examination* discloses a solid density of the right apex sharply outlined downwards. *Tomography* shows a roundish sharply outlined shadow, 6 to 7 cm, compressing the main bronchus. In hilus a globoid shadow about 2 to 3 cm.

Microscopic examination (The University Institute of path. anatomy. 1978/43): The stroma is abundant with marked infiltration of leucocytes in the connective tissue encompassing isles of varying size of undifferentiated small epithelial cells changing centrally into somewhat bigger and brighter cells. Slight traces of cylindromatous pattern make the picture suggestive of a mixed tumour of the salivary gland, stellate cells and cartilage being, however, absent. In some of the isles, traces of squamous metaplasia are detected. No signs of secretion.

Histological diagnosis. Solid bronchial adenoma with cylindromatous areas.

Case 10. Man, aged 22. (The Øresundshospital. 12182. S30/41. Published by KJÆR & PETERSEN, Case 1.) Five years ago an attack of pleurisy lasting two months. Since then he has been under control with regard to tuberculosis. In the lower part of his right lung a density is later discovered. His chief complaints are fatigue and pain in his right chest. Recurrent attacks of "colds".

Bronchoscopy: somewhat down the right bronchus beneath the branching of the middle lobe bronchus there is a narrowing of lumen into a crescent-shaped cleft occasioned by a greyish-red smooth tumour bleeding easily. Extirpation is made through the bronchoscope (KJÆR) with subsequent electrocoagulation of the tumour site, after which the symptoms disappear.

Microscopic examination of the removed tissue shows solid nests of small cubical to cylindric cells forming in some places glandular lumina. There is no marked atypical growth, no mitotic figures. The picture is characteristic of a bronchial adenoma. The patient is discharged. Three years afterwards he is re-admitted with similar symptoms located in the same region as before. A

recurring tumour is removed by bronchoscope, 1 by-1 cm in diameter.

Microscopic examination of recurrent tumour (The Path. Institute of the Kommunehospital, 147/44, fig. 18). The small piece of tumour tissue is lined by a normal bronchial mucous membrane. Directly under this, and without any screening capsule a mass of cells are arranged in big and small nests. Their nuclei are small, darkly staining globoid uniform. In most areas the cytoplasm is dark-coloured, at times, however, it is light, translucent, somewhat vacuolized. Staining for mucus is negative. Mitotic figures are absent. Tumour cells are invading the connective tissue and the lymphatics. There are no atypical cells.

Histological diagnosis: Recurrent bronchial adenoma of solid type.

Case 11. Man, aged 45. (The Rigshospital, Surgical Dept. Polyclinic. 2097/43.) Since an attack of pneumonia one month ago he has had several attacks of what is diagnosed as "influenza", finally hemoptysis. *Bronchoscopy* reveals a tumour occluding the right middle lobe bronchus. *Roentgen examination* shows a block corresponding to the middle lobe. Radon seeds are inserted.

Microscopic examination (The University Institute of path. anatomy. 2802/43) of the biopsy material: shows solid epithelial isles in a rather abundant fibrous stroma containing numerous blood vessels. The picture is resembling that of *Case 7*: big bright cells with a light cytoplasm which does not stain by mucus staining. A few mucous glandular elements of ordinary bronchial gland type are found under the capsule, with some signs of secretion stasis (fig. 19). In this case, however, no transformation into tumour cells is seen. No mitotic figures.

Histological diagnosis: Bronchial adenoma with secretion.

Case 12. Woman, aged 38. (The Rigshospital, Dept. R. 268/43.) 8 years prior to admission she had a right-sided pleurisy. During the last 3 years fatigue and loss of weight. Repeated periods of fever and pain in her chest. A pulmonary abscessus is necessitating hospital treatment. After emptying of the abscessus by pneumotomia her condition is ameliorated. *Bronchoscopy* now discloses, some 5 cm down the left main bronchus a smooth, shining red occlusive tumour bleeding profusely. In spite of a complete pleural symphysis and recurring inflammatory processes in the lung, lobectomy is attempted. It is however necessary to alter the operation to a complete pneumonectomy (HUSFELDT) but the patient cannot support the extremely exhausting operation and dies soon after.

Autopsy (The University Institute of path. Anatomy 372/43) reveals

no metastases and, on the whole, apart from the lungs, no findings of special interest.

The removed lung (fig. 20) contains a tumour measuring 3.5 by 3.5 by 4 cm. arising from the wall of a strongly dilated bronchus. It is broadbased, of soft consistence and apparently well delimited.

Microscopic examination (The University Institute of Path. Anatomy. 3073/43):

The big tumour is composed of cords of cubical to cylindric cells lying in a scanty fibrillary stroma. The cords are closely packed and the tumour, thus, very rich in cells. Neither the cells nor the nuclei are of a quite uniform appearance, polymorphous and atypical features being traced in some areas but mitotic figures are absent. In the basal portion of the cells traces of initial secretion are seen as bright vacuoles of secretion lifting up the nucleus from the basement membrane. Both in the stroma and in the capsule there is marked invasive growth (fig. 21). In the capsule differentiation of bone tissue has taken place, but not in the tumour tissue proper. Notwithstanding the abundance of cells and the varying size and shape of the cells and the nuclei, no incontestable signs of malignancy are found. Staining for mucus is negative.

Histological diagnosis: Solid trabecular bronchial adenoma with slight secretion.

Out of the 12 cases described above, 11 displayed typical bronchial adenomas whereas the tumour in the 12th case (Case 5) presented remarkable features suggestive of malignancy. In one of the typical cases (Case 10) recurrence was observed 3 years after removal of the primary tumour. The adenomas occurred in seven men and four women, their age ranging from 16 to 58 years. In all the cases with the exception of two: Case 8 in which the symptoms set in suddenly, and Case 2 in which the bronchial adenoma was an accidental finding at autopsy, the same symptoms of occlusion of the bronchus were noted: dyspnoe and cough, expectoration, in some cases hemoptysis, pain, loss of weight and fever. In Case 7, 9 and 12 the symptoms lasted some months, in Case 1, 3, 4, 6 and 11 one to ten years.

Mention has not been made of bleedings synchronously with the menstrual periods.

Bronchoscopy was performed in all ten cases in which the tumour was discovered in the patient while alive disclosing in all cases the characteristic picture of an occluding smooth globoid broad-

based tumour bleeding easily and located in a main bronchus or in one of the main bronchial branches.

In 3 cases (Case 1, 7 and 10) extirpation and subsequent electro-coagulation of the tumour site was performed, in 4 cases (Case 4, 6, 9 and 10) insertion of radon seeds was made whereas in 3 cases (Case 3, 8 and 11) tumour was necessitating a lobectomy (pneumonectomy respectively). All patients except one (Case 11) who died directly after the pneumonectomy, made a perfect recovery.

It will be seen that the microscopical structure of all tumours here recorded is in perfect keeping with those of previous reports. In 8 cases the stratified squamous epithelium was covering the smooth surface of the tumour and in ten of the cases the fibrous capsule was found.

In all the cases, the tumour cells correspond to those described by previous authors e.g. HAMPERL, or particularly by BRUNN & GOLDMAN whose description shall be quoted: "The cell type which characterizes bronchial adenoma is a small cuboidal or polygonal cell, which is uniform, with an oval or round, darkly staining nucleus. The chromatin is finely divided and there are no large nuclei. Mitotic figures are absent. There is a tendency for cells to be grouped and to form several types of patterns. These may be distinguished as alveolar, columnar, medullary, acinar, mosaic and angiomatoid patterns. A delicate reticular stroma runs through the tumour, encompasses the groups of cells and is contiguous with the fibrous capsule. At times the stroma surrounds large vascular spaces. Particularly at the periphery of the endobronchial portion of the tumour, vascularity is apt to be prominent. In some cases the histological pattern is uniform throughout the whole tumour, in others the patterns vary a great deal."

To this description may be added that in some cases (Case 4, 7, 10 and 11) secretion of the cells was seen, in part as a production of mucus as described by HAMPERL, in part, as a vacuolization of the cells lending the picture certain features reminding of those of a hypernephroma (fig. 16). Oncocytes as described by HAMPERL have not been found in our cases.

It is of importance that cartilage was not seen in any of these tumours neither in the stroma nor as a result of epithelial differentiation. Bone tissue was observed in 2 cases (Case 3 and 11), in both cases, however, in the fibrous capsule only and not in the tumour tissue proper (fig. 8). Other tissue elements as muscular cells, fat and the like have not been traced.

In all the cases invasive growth in the capsule and in the stroma was observed, in one case (Case 2) even in the perineural sheaths (fig. 5), contrasting most remarkably to what has been described by HAMPERL. Recurrence of tumour was encountered in one case (Case 10) (fig. 18).

Systematics and Histogenesis of the Bronchial Adenoma.

As already mentioned, various authors have suggested a distinction between two groups of bronchial adenomas viz.: the cylindromas and the rest, emphasizing the analogy between the latter and the mixed tumours of the salivary gland (KRAMER & SOM, HAMPERL).

All apart from the fact that the term: "cylindroma" is based upon morphology only and does not represent any independent tumour I should — judging from my own material — prefer not to adopt this classification of the bronchial adenomas.

Cylindromatous pattern, certainly, was found in two of my cases (Case 2 and 9), but in Case 2 typical areas and solid trabecular and alveolar areas were seen side by side, and the whole architecture of the tumour with its covering layer of stratified squamous epithelium, its fibrous capsule with its traces of adenomatous structure, and, finally, with its angoid areas — does altogether classify this tumour as a typical bronchial adenoma with cylindromatous areas. It may hardly be right to regard it as a "cylindroma" differing from other bronchial adenomas. The same may be said of Case 9 which, in addition, showed a tendency towards squamous metaplasia, as was the case in Case 4 too.

Thus, judging from the cases here reported, there will be no reason of separating one special group of "cylindromas" from the bronchial adenomas, recognizing, on the other hand, that cylindromatous pictures may develop in bronchial adenomas as in various other epithelial tumours.

No more do these cases justify a marked distinction between a solid non-secretory type and an adenomatous secretory type.

Yet — to be sure — as far as the age of the patients is concerned there seems to be a certain difference between the adenomatous and the solid tumour types.

In reviewing 59 cases from the literature, permitting of a classification of the tumours, we have found 18 purely or chiefly adeno-

matous tumours and 41 merely solid tumours without signs of secretion. In the literature, in addition, 4 mixed cases and a large number of cases were found in which the histological pictures were not described at all or too insufficiently described to permit of a classification.

Among the adenomatous tumours 5 were observed in men, 13 in women, the average age being 45 and 41 respectively. The non-secretory solid type occurred in 15 men and 26 women, the average age being 40 and 34 years respectively.

The ratio: male-female, thus, is about the same within the two groups, whereas with regard to the average age of the patients the adenomatous type is surpassing the solid one by about 5 years.

This, however, does not indicate that it is a question of two different tumours, since the highest differentiated tumours are often found in higher age-classes than corresponding tumours of lower differentiation.

Also the cases in which "mixed-tumour-types" were encountered speak against a distinction of two different groups. In 4 out of the 12 cases here reported (Case 1, 3, 5 and 8) tumour was composed of non-secretory epithelial cells. Case 6 with its partly adenomatous structure (found also as traces in Case 1, 3 and 10) represents a transition from this picture into the more pronounced glandular adenoma (Case 4) with its strongly positive mucus staining of the glandular cytoplasm and of the secretion of the glandular lumina. This we already know from previous authors e.g. HAMPERL but it must be emphasized that the epithelium of the bronchial adenomas also may display traces of another secretion type.

Case 12, an otherwise typical trabecular, solid bronchial adenoma, is showing a few translucent empty vacuoles in the cell cytoplasm, chiefly at the base, lifting up the nucleus from the basement membrane. This picture is found still more pronounced in Case 7 in which tumour was equally solid without glandular structure, and in Case 11 in which nearly all cells are changed into big spongy vacuolized cells reminding of the cells of a hypernephroma. These cells do not stain with mucicarmine, and there is — as mentioned above — no glandular arrangement of the cells.

Thus, there exists, a gradual transition from the undifferentiated solid adenoma, in part into an acinous mucous type and, in part, into a solid type with bright vacuolized cells simulating a hypernephroma. Like the cylindromatous types, these varying pictures, no doubt, must be interpreted as special differentiation stages of

the same type, viz.: the solid, poorly differentiated bronchial adenoma with small dark cells.

As already mentioned, bronchial adenomas have repeatedly been compared and even identified with mixed tumours of the salivary gland type. It is not, however, quite certain that this view must be accepted unconditionally.

It is true that there may be a strong resemblance between the histological picture met with in some bronchial adenomas and those of the mixed tumours of the salivary gland, as may be seen from the Case 4 and especially from Case 9 in which there was a tending towards reticular arrangement of the epithelial cells, to cylindromatous pattern and squamous metaplasia as known from the mixed tumours of the salivary glands.

But in the bronchial new growths, a series of features which characterize the mixed tumours will be completely lacking. There will, thus, be no mucoid-myxomalike tissue, no chondroid areas developing from a tissue reminiscent of embryonal mesenchyma. As said above, reports have been given of bronchial adenomas in which cartilage had developed, but as repeatedly emphasized, it is not a question of chondroid transformation of cells derived from the tumour cells proper as is the case in the tumours of the salivary glands. It is a real, fully developed hyaline cartilage arranged in well defined nests in the connective tissue stroma. The picture, thus, is quite different from that of the mixed tumours of the salivary glands. The same holds true of the bone formation which may take place sometimes e.g. in our Case 3 and Case 12, but only as bone lamellæ in the fibrous capsule encompassing the adenomas. Finally, lymphatic infiltrations are missing in the bronchial adenomas, characteristic though of the mixed tumours. Also the transition into stellate cells characterizing the mixed tumours, will not be found in bronchial adenomas.

Hence, there will be no reason to draw so close an analogy between these two tumour types as previously done. Essential features of the salivary gland tumours are not encountered in the bronchial adenoma. The said lacking of chondroid and mucoid components staining positively by muci-carmin renders it questionable whether a similarity as to arrangement of the epithelial cells may authorize a parallelizing of these two groups, and the more so as the epithelial arrangement met with in bronchial adenoma in most cases will differ essentially from that of the tumours of the salivary glands.

Another feature supporting the view that the mixed salivary tumours and the bronchial adenomas are two different tumour types is the proneness of the latter to differentiate into true adenomas with a mucous or a more watery secretion.

Origin of Bronchial Adenomas.

It, thus, seems reasonable to assign to the bronchial adenoma a separate place within the group of epithelial tumours.

As already mentioned, a number of diverging theories have been advanced as to the derivation of those cells and tissues of which the bronchial adenoma is composed. It is now generally acknowledged that it arises from the glandular elements in the bronchial wall or from their secretory ductuli. Up till now this conception has been based on conclusions only — albeit rather probable conclusions —, but the cases here reported seem to display features leading more directly to the same interpretation.

In Case 11, a few remainders of intact terminal portions of mucous glands from the bronchial wall are found within the capsule, viz.: in the tumour tissue proper. These elements showing some secretion stasis with dilated acini are, thus, supporting the view that the tumour is arising from elements of these glands incorporated in the tumour tissue proper so as to cause easily a compromising of their ductuli.

More remarkable still are the findings in Case 3 and 4. In Case 3 remainders of bronchial glands with ample normal mucous secretion dilating the acini are likewise found. At the ductus, however, the character of the epithelium is gradually changing into small cubical uniform cells, morphologically indiscernible from the solid strands of the tumour cells encompassing the gland (fig. 9). KRAMER (1930) in describing a similar picture found, in addition, metaplasia into squamous epithelium.

In Case 4 a similar picture is found presenting another new feature. As in Case 3 dilated but otherwise normal mucinous acini are seen. At the passing into the ductuli and beneath the intact flattened glandular cells there are one or more layers of small polygonal epithelial cells presenting the same appearance as do the cells of the tumour tissue (fig. 10, 11). In some places these cells are seen invading the area beneath the glandular cells of the terminal portions.

How to explain this picture may perhaps be doubtful. The small undifferentiated cells located between the glandular cells and the basement membrane, no doubt, are identical with the tumour cells, their origin being, however, more obscure. It may hardly be a question of direct transformation of the glandular cells, more probably they have origin in the epithelium of the ductuli as suggested by KRAMER. The picture displayed in Case 3 is favourising this view. It cannot, however, be excluded, that we must seek the origin of these cells in the basket cells of myo-epithelial origin located between the true glandular cells and the basement membrane. The findings made in Case 4 seem to support this explanation although the differentiation potency of the tumour cells towards glandular cells is speaking against it.

It is, thus, beyond doubt that these tumours have origin in the bronchial glands and, most likely, in the epithelium of the ductuli.

May Bronchial Adenoma Undergo Transformation into Carcinoma?

It has already been stated that obvious invasive growth in all 12 cases takes place in the stroma (fig. 21) and in the fibrous capsule surrounding the tumour tissue. In Case 2 there was even solid invasion of perineural lymphatics in the neighbourhood of tumour (fig. 5). Apart from this, the tumours were characterized by the lacking of signs of malignancy e.g. polymorphous and atypical cells and mitotic figures. Nevertheless, it is nearly as sure as fate that the histologist will — just because of the invasive growth — make the diagnosis of a solid carcinoma or an adenocarcinoma when for the first time he is facing bronchial adenoma. The clinical course and the absence of metastases are, however, facts which will unmistakably evidence their clinical benignity. The invasive growth which is often exceedingly pronounced may perhaps be explained in the following way: The tumour cells are only able to keep alive as long as their contact and continuity with the mother tissue is intact. Isolated and displaced from their origin they must die. This accounts for the fact that there may be invasion of the neighbouring tissue but no real metastases.

The basal cell carcinoma of the skin is displaying similar findings explaining the markedly rare occurrence of metastases.

Hence, the discussion concerning the benign or malignant nature of the bronchial adenoma, may very easily become a

mere combat of words. In recapitulating we must say that they are tumours capable of strong invasive growth but displaying no mitotic figures and no atypical cells otherwise characteristic of carcinoma. Their clinical benignity viz. their remarkably slow rate of growth, their lack of metastases in spite of a certain tendency towards recurrence (Case 10) altogether are features which do not alter the fact that from a histological point of view they are displaying at least one malignant feature, viz.: the invasive growth.

In some of the cases here described additional features were encountered which were suggestive of malignancy, in one case even justifying the diagnosis of a carcinoma arising from a bronchial adenoma.

Case 8 — a typical solid bronchial adenoma in a female, aged 16, shows a series of peculiar features.

In sharp contradistinction to the rest of the cases, the cells are here strongly polymorphous: oblong, globoid or cuboidal, the polymorphous appearance of the nuclei being still more marked, with at times unusually big nucleoli which will not be seen in ordinary bronchial adenoma. Mitotic figures are, however, absent. The changes of the cells and nuclei combined with the invasive growth that has broken through the capsule (fig. 17) and invasion into a lymph node — are all features suggestive of malignancy. Owing to the pneumonectomy performed, no information could be achieved concerning recurrence or subsequent metastases in this case.

A remarkable fact is that in this case tumour cells were found in the sputum, a feature highly suggestive of malignancy. In typical bronchial adenomas the sputum contains no tumour cells.

The tumour in Case 5 is still more suggestive of malignancy. In a man, aged 72, a big sessile tumour has developed in the bronchus (fig. 12). The tumour cells — although presenting the same type as that found in the common bronchial adenomas, are strongly varying in shape and size, their nuclei are polymorphous and there are numerous atypical mitotic figures (fig. 13), invasive growth, but no metastases. The polymorphous cells and the abundance of mitotic figures will place this case into a special class and justify the diagnosis of carcinoma. The macro- and microscopical pictures taken together, thus, are suggestive of a bronchial adenoma which has undergone transformation into malignancy.

Judging from this case together with those reported in the literature — especially the case described by KERNAN in which tumour

cell emboli were found in the blood vessels, and the case recorded by HECK displaying the same features as our Case 5 and metastases in a lymphnode in addition — it may be taken for granted that bronchial adenomas actually may undergo transformation into carcinomas. The theory advanced by LAFF as to their potential malignancy, thus, is justified. That this latent malignancy will only seldom manifest itself, is still another question, though of the greatest importance to the clinician.

Attention must be called to the fact that all cases of bronchial adenomas identified as malignant are belonging to the group of solid, non-secretory adenomas viz.: the most poorly differentiated type, whereas reports have not been given of adenomatous tumours changing into carcinoma.

Conclusion.

The benign bronchial adenomas, as a rule, are small (1—4 cm.) encapsulated tumours located in the wall of a main bronchus and occasioning a more or less marked occlusion of its lumen. They are composed of small, uniform, epithelial cells of varying arrangement: alveolar, trabecular, adenomatous, angoid. At times there is differentiation towards mucus-secreting cells or big translucent vacuolized cells. Cylindromatous pattern, likewise, may occur. These strongly varying pictures are held to be different manifestations of the same tumour. Transition from one picture into another has been encountered.

Neither atypical cells nor mitotic figures will be found, but most frequently a marked invasive growth in the capsule that may exceptionally be broken through. As a rule metastases are absent. The growth of the tumour is remarkably slow.

The bronchial adenomas in rare cases may undergo malignant transformation with polymorphous and atypical cells, numerous mitotic figures and metastases.

These tumours have origin in cells of the mucous glands in the bronchial wall, either the ductuli epithelium or the basket cells of the glandular terminal portions.

Summary.

After reviewing of the literature report is given of 12 cases observed by the author (7 men and 5 women).

In all essentials, the structure of the tumours is corresponding to that of previously reported cases. Differentiation into cartilage from tumour cells has not been noticed, and there are no findings favouring the view that these tumours should be analogous to the mixed salivary tumours.

No more would it be justifiable to distinguish between two groups of bronchial adenomas. The tumour cells may display a varying degree and tendency of differentiation. Undifferentiated as well as more differentiated types (occurring mostly in relatively old individuals) may be found. The differentiation may tend towards cylindromatous pattern or towards glandular epithelium, mucous or non-secreting, at times metaplasia into squamous epithelium will be seen, and, in fact, all these pictures may appear mixed up in one and the same tumour.

In three cases pictures suggestive of direct change of bronchial glands into tumour tissue were met with. The tumour cells seem to have origin in the ductuli epithelium or maybe in the basket cells of the acini.

Invasive growth was observed in all 12 cases. In one case there was solid invasion of perineural lymphatics, in another tumour cells had broken through the capsule. In one case tumour recurred 3 years after removal of the primary tumour, and, finally, in one case there were well defined malignant cell pictures with polymorphous cells and numerous, in part, atypical mitotic figures. The constant absence of metastatic deposits is proposed to be due to a poor vitality of isolated tumour cells, after the analogy of the basal cell carcinoma of the skin.

Recent experience, thus, has evidenced that these tumours although generally benign, may — at any rate from a biological point of view — undergo malignant change.

Zusammenfassung.

Nach einer Übersicht der betreffenden Literatur teilt Verf. 12 eigene Fälle mit (7 bei Männern, 5 bei Frauen).

Die Struktur der Geschwülste entspricht im grossen Ganzen derjenigen früher mitgeteilter Fälle. Keine Entwicklung von Knorpel in den Tumoren wurde beobachtet, und es liegen überhaupt keine Anhaltspunkte vor, eine Analogie zwischen diesen Geschwülsten und den Mischgeschwülsten der Speicheldrüse aufrechtzuhalten.

Auch scheint es unberechtigt, die Bronchialadenome in mehrere Untergruppen zu teilen. Verschiedene Stufen und Richtungen der Differenzierungen sind vertreten, indem sowohl ganz undifferenzierte als auch mehr differenzierte Formen vorkommen (die letzteren besonders bei relativ älteren Individuen).

Ausser den gewöhnlichen undifferenzierten Tumoren werden Bilder vorgefunden, in welchen zylindromatöser Aufbau, muköses oder nicht-muköses Drüsenepithel, oder Plattenepithel vorherrschen, oder sogar unter einander gemischt in einer und derselben Geschwulst auftreten.

In drei Fällen finden sich Züge, die auf einen direkten Übergang vom Bronchialdrüsengewebe ins Tumorgewebe deuten. Die Geschwulstzellen scheinen von dem Ductuliepithel oder vielleicht von den Korbzellen der Azini auszugehen.

In sämtlichen 12 Fällen wurde invasives Wachstum nachgewiesen. In einem Fall fand sich massive Invadierung eines perineuralen Lymphraumes, in einem anderen Durchbruch der Kapsel. In einem Fall traf Rezidiv 3 Jahre nach der Entfernung der primären Geschwulst ein, und schliesslich bot ein Fall eindeutige maligne Zellerscheinungen mit Polymorphie und zahlreichen, teilweise atypischen Mitosen dar.

Metastasen wurden nicht nachgewiesen, was möglicherweise dadurch zu erklären ist, dass Tumorzellen, wenn sie isoliert auftreten, weniger lebensfähig sind, ein Befund, der mit den Basalzellenkarzinomen der Haut analogisiert werden kann.

Es ist somit festgestellt worden, dass diese Geschwülste — wenn auch vorwiegend als gutartig aufzufassen, ausnahmsweise — jedenfalls im biologischen Sinne des Wortes — malign werden können.

Résumé.

Après un aperçu de la littérature douze cas personnels (7 hommes et 5 femmes) sont rapportés.

La constitution des tumeurs correspond pour l'essentiel à celle observée dans des cas précédemment rapportés.

Les cellules tumorales n'ont pas subi la différenciation cartilagineuse, et l'examen microscopique n'a en somme rien relevé qui permette de concevoir ces néoplasmes comme étant analogues aux tumeurs mixtes des glandes salivaires.

On n'a rien trouvé non plus justifiant une subdivision en sous-groupes des adénomes bronchiques. La différenciation du tissu

tumoral est variable. Il s'observe des formes indifférenciées et des plus différenciées (qui semblent apparaître chez les malades relativement avancés en âge). La différenciation peut être à type cylindromateux, ou elle peut affecter le type de l'épithélium glandulaire, muqueux ou non, ou de l'épithélium pavimenteux. Parfois ces diverses formes coexistent dans une même tumeur.

Trois cas offrent des aspects interprétés comme passage direct de glandes bronchiques à tumeur. Les cellules tumorales semblent dériver de l'épithélium ductuli ou peut-être de cellules en panier dans les acini.

Tous les douze cas présentaient l'aspect d'un accroissement envahissant. Dans un cas un envahissement massif des fentes lymphatiques périneurales a été observé, et dans un autre il y avait infiltration de la capsule. Un cas a récidivé trois ans après l'ablation, et un cas enfin a offert des aspects nettement malins avec polymorphisme et nombre de mitoses en partie atypiques.

Des métastases n'ont pas été observées, ce qui s'explique en admettant que les cellules néoplasiques isolées ne peuvent subsister, comme il en est le cas pour certains épithéliomas basocellulaires de la peau.

Bien que ces tumeurs soient d'habitude bénignes, il faut constater que, biologiquement au moins, elles peuvent prendre une évolution maligne.

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From the Orthopedic Clinic (Vanförestalten) of Karolinska
Institutet, Stockholm. (Prof. S. Friberg).

Division of the Fourth Lumbar Nerve Root in Treatment of Arthritis Deformans of the Hip.

By

ANDERS KARLÉN.

Division of the fourth lumbar nerve root as a treatment for arthritis deformans of the hip was first put into practice by VON REIS, SAHLGREN, and SJÖQUIST, who described their experiences for the first time before a meeting of the Swedish Society of Neurologists at the St. Erik's Hospital, Stockholm, in 1943. As the result of an investigation on the distribution of muscular hyperalgesia in connection with this type of hip affection, VON REIS had come to the conclusion that the muscular pain must be regarded as a reflex pain ("referred pain") which is transmitted mainly by way of the fourth lumbar segment. The ontogenetic and phylogenetic studies of BOLK, as a result of which this author had concluded that there is a strict correlation between the natural tendencies and the distribution of bones, muscles, and nerves, were considered by VON REIS to provide further evidence in support of his theory. The sclerozone of the fourth lumbar myomere is said to be situated within areas of the skeleton embracing in the main parts of the acetabulum, and BOLK also pointed out that, as far as their proximal aspect is concerned, the head and neck of the femur have the sixteenth sclerozone, or in other words the fourth lumbar segment, to thank for their origin. Working on these assumptions, VON REIS submitted four patients to operation; in three instances the division of the fourth lumbar root was done outside the dura mater, both the motor and the sensory branches thus being included, and in the fourth

case only the sensory root was crushed, the intervention in this case being intradural. All these patients were exhibited at the Meeting. Three of them had lost their pains while in the fourth the condition was as before. The observation time in every instance was extremely short, however, as may be seen from the following quotation taken from the article by VON REIS, SAHLGREN, and SJÖQUIST: "While it is admitted that to draw definite conclusions from these operations is a little premature, seeing that the patients are still suffering from the after-effects of the actual operation, we should nevertheless like to place on record that, in our opinion, division of the fourth lumbar nerve root to relieve painful hips arising from arthrosis deformans and not yielding to conservative treatment can for the present be definitely regarded as an adequate operative method having every prospect of bringing alleviation, and even at best of eliminating entirely these obstinate pains."

The results certainly seemed encouraging, in consideration of the difficulties, from the therapeutic point of view, which have always been, and must continue to be encountered in this type of case. OLIVECRONA, in an article in *Nordisk Medicin*, made the following statement regarding the use of chordotomy in arthrosis deformans of the lower extremities: "As regards the hip joint, freedom from pain can be achieved, as has been demonstrated by VON REIS, SAHLGREN, and SJÖQUIST, through division of the fourth lumbar nerve root, this root being apparently the only one having any part in the innervation of the hip." NORLÉN, who performed the operation on one of VON REIS's cases, also considered the method to be well-founded, and the results he had obtained with it were in his opinion such as to warrant a continuation of its use. In 1944, he published a report on the results in 5 cases, one of these being that mentioned by VON REIS. Three of them were typical cases of arthritis deformans of the hip, in one instance necrosis of the femoral head was present in conjunction with the arthritis deformans, and in the fifth the patient was only suffering from pains in the region corresponding to the fourth lumbar segment. In every case the initial result had been extremely favourable as far as the pains were concerned. No reference was made to the length of the postoperative observation time nor to the patient's subsequent ability to work.

Unfortunately, subsequent results did not come up to the standard of those originally obtained. This fact was admitted by

VON REIS, in a later article published in *Nordisk Medicin* in 1944, in which he reported the results achieved in eleven operations. Of these, five were either much improved or free from pain at the time the article was in press, while in 6 cases there had been no appreciable improvement. The observation times in both these groups also were short, from one to six months. In one instance, owing to an error, the fifth root was divided instead of the fourth, and in this patient the muscular tenderness on pressure remained as before, and the pains were not alleviated. The power of dorsal flexion in the feet was noticeably weakened, however. VON REIS summarized his impressions of the method as follows: "Division of the fourth lumbar nerve root is not always an adequate measure for alleviating or eliminating the pains occurring in arthrosis deformans of the hip.

To ensure a satisfactory end-result, therefore, it seems that one or possibly even two more roots should be divided. Investigations now in progress may provide more information on this point. Only the sensory root should be touched, since it has been found in isolated cases that division of both the motor and the sensory roots caused crippling paresis.

As it is not yet possible to lay down definite rules as to the best technique for achieving a result perfect from the neurologic standpoint, division of the fourth lumbar nerve root should not be used indiscriminately as a treatment for painful hips arising from arthrosis deformans".

In 1944, finally, WAHREN described the results he had obtained with the 5 patients upon whom he had used the method. In one of these the result had been excellent, and the effect was still good after an observation time of five months; in one there was a definite improvement, while in the other 3, after an initial improvement, there was a relapse to the original condition.

In view of the good results reported at the meeting of the Neurological Society the method was taken up by the Stockholm Orthopedic Clinic. A total of sixteen patients have been submitted to the operation. Fifteen of them were suffering from arthritis deformans and the sixteenth had a chronic, degenerative arthritis of unknown origin. The latter case is not included in the investigation reported in this paper. In 8 patients monolateral division of the fourth lumbar root was done, in 3 monolateral division of the fifth root, and in 1 monolateral division of the third root. In 2 of the patients the technique adopted was bilateral division

of the third and fifth lumbar roots, respectively, and in 1 case the fourth lumbar root on one side and the fifth on the other were cut. In every instance the procedure was extradural, both the motor and the sensory roots thus being divided. The reason why radicotomy of the fifth root was done in no less than 6 cases was that, as the initial result was extremely satisfactory in the 2 patients upon whom this was done in error, it was thought that the measure was worth trying in the case of a few more patients.

As far as the pains were concerned, the initial results were good in every instance, the previously-suffered discomfort being either relieved or totally cured. In six cases it was possible to confirm the results by means of pre- and postoperative, intraarticular injections of hypertonic saline solution (6 per cent) mixed with 35 per cent perabrodil. The perabrodil was added to the salt solution in order that it could be proved roentgenographically that the saline had actually passed into the joint. Of these 6 cases 2 belong to the group in which the fourth lumbar root had been divided, and 4 to that in which the fifth root was cut. Complete analgesia was obtained in connection with the postoperative injection in 2 of the patients in whom the fifth root was divided and in 1 subjected to radicotomy of the fourth root. All of these patients had experienced an increase in the intensity of the pain in connection with the preoperative injection of the hypertonic saline solution.

For the follow-up investigation, the vertebrae were counted from the occiput in every instance, in order that the level at which the operation had been done could be established with certainty. The wisdom of this measure was apparent when it was found that in one patient there was lumbarization of the first sacral vertebra.

The length of the postoperative observation period varied from 3.5 to 10.5 months. In 10 cases it was over 6 months. Only in 1 instance was it as short as 3.5 months. The last-mentioned patient had such intense pain in the hip as early as two months after the operation that an arthrodesis had to be performed, this being done 3.5 months after the first intervention. It is not yet possible to judge the result of this last operation, as the patient is still undergoing treatment. This case belongs to the group in which the fourth lumbar root was divided.

Nine of the cases were women whose ages ranged between 51 and 70 years, the average age being 59 years. Six were men be-

tween the ages of 46 and 77 years. The average age in this group was $60\frac{2}{3}$ years. They were all suffering from serious forms of arthritis deformans of the hip joint, some of them having had no benefit from long-continued conservative treatment and others being in such a condition that this form of treatment had been considered to be useless.

When the results were to be estimated it was necessary to consider not only whether there was any improvement in the spontaneous pain in the hip, but also whether the operation had had any effect on the pains caused by movement, the pain from weight-bearing, and the walking ability. Possible complications in the back, or troublesome symptoms of nerve injury also had to be investigated. To judge the effect on the basis of the post-operative ability was not likely to yield information of any value, since most of the patients were of an age at which strenuous bodily activity was no longer possible.

The third lumbar root was divided in 3 instances, the operation being unilateral in 1 case and bilateral in 1. At the re-examination it was found that in both cases the operation had favourably affected the spontaneous pain in the hip but both patients still suffered from pain on progression. One of them, a 60 year old woman, experienced great pain when walking, and when re-examined ten months after the operation she could only walk with the aid of two sticks. When at home she got about supporting herself on a chair, a tea-trolley, or some other similar piece of furniture. At her last visit to the hospital she was provided with a bath-chair to aid her in getting about at home. There were no back pains in this case. The other patient, on the other hand, a man of 68, reported that he suffered from his back when bending his body or making other similar movements. The preoperative roentgen examination of the lumbar vertebrae in this case had shown an advanced spondylitis deformans.

Radicotomy was performed on the fourth lumbar root in 9 instances. In every instance the initial result had been reported to be favourable but the good effects were only lasting in 3 of the patients; in 2 of the others the condition deteriorated to a state worse than it had been originally, and as regards the remaining patients the initial improvement was only temporary and the condition is now the same as it was before the operation. The 3 patients in whom the improvement has been lasting are now completely free from the spontaneous pain, and to a certain

extent also from the pains caused by movement. In one instance there are rather severe back pains. As regards the 2 patients in whom the condition had deteriorated, one of them, a warehouse assistant aged 53, was considerably improved, one month after the operation. He himself described this improvement by saying that "there was no comparison between this condition and the condition he was in before the operation". After a time, however, his hip began to deteriorate again, and a little over two months after the operation he was suffering from a nagging pain night and day; he could only manage to sleep for a couple of hours each night and could only walk a few steps at a time. He was operated upon again 3.5 months after the radiotomy, a partial intra- + juxta-articular arthrodesis being performed. The other case in which there was a deterioration was that of a retired seaman, a man of 77 who stated at the re-examination 9.5 months after the operation that the condition of his hip seemed to be the same as it had been prior to the operation but that his condition in general was worse because he was now suffering from severe back pains, these being severer than the pains in his hip. The roentgen examination carried out before the operation had shown that a maximum degree of spondylitis deformans was present in the region of the lumbar vertebrae, a condition which had up to that time caused him no discomfort whatsoever. As regards the remaining 4 cases, the spontaneous pain in the hip had been favourably affected in every instance. In one case, eight months after the intervention, there was considerable pain in the hip on weight-bearing, and in another pains in the joint were experienced after the patient had been walking a couple of hundred metres. Details on the pains arising in connection with movement are lacking with regard to the other 2 patients. One of these, a wood-cutter aged 53, had done his ordinary work during the winter months, but he reported that after the operation it was more difficult to work, not only because his back was stiffer but also because, owing to the weakness of his leg, it was troublesome to walk in deep snow. The pre-operative roentgen examination had shown a moderate degree of spondylitis deformans. Another of the last-mentioned 4 patients also reported at the follow-up investigation, 10.5 months after the operation, that he was suffering from severe back pains; in this case the roentgenogram taken before the operation had revealed the presence of a mild degree of spondylitis deformans in the lumbar region.

As has already been mentioned, the radicotomy was performed on the fifth lumbar root in 6 cases. On the whole, better results were obtained with these patients than with those treated by radicotomy of the fourth root. The initial result of the operation was always good, and the spontaneous pain disappeared completely. In this respect, the improvement was lasting in 5 instances, but in the case in which the operation was bilateral, there was a deterioration on one side a few months after the intervention, the condition here becoming worse than it had been prior to operation. An arthroplasty, interposing a fascia lata, has now been done on this side, but the operation is too recent for the result to be judged. One patient had no pains on exertion when re-examined five months postoperatively, 4 patients experienced pain on walking (1 after about 400 metres, 1 after a few minutes' walking, 1 after 1½ kilometres, and 1 after exertion). Four of the patients reported back pains at the re-examination, and 2 stated that the power in their leg was worse than it had been before the operation. In no case was there any mention of symptoms of paresis in the dorsal extensors of the foot; nor was any sign of this found at the clinical examination.

In order to form a better idea of the success achieved with these radicotomies the results have been tabulated (table 1), consideration having only been taken, however, to the effect of the operation on the pains in the hip. The results were judged according to the following principles.

A good result = Elimination of both spontaneous pain and the pain arising on movement.

A satisfactory result = Elimination of the spontaneous pain and

Table 1.

Results with respect to spontaneous pain and pain on movement in hip, in arthritis deformans of the hip joint treated by radicotomy on the third, fourth, and fifth lumbar roots.

Result	Radicotomy on		
	3rd lumbar root	4th lumbar root	5th lumbar root
Good	—	—	1
Satisfactory	—	3	4
Poor	3	3	—
Bad	—	3	1

partial elimination of the pain on movement. (Patient capable of walking at least 500 metres without pain.)

A poor result = Elimination of the spontaneous pain but no effect on the pain experienced on movement.

A bad result = An unchanged or worse condition.

Further investigation is necessary before it can be decided which type of cases should be submitted to the operation, a statement which has also been made by one of the originators of the method (VON REIS). It would seem, however, as if the radicotomy should be extended to include more than one nerve root. Only the sensory root should be cut or crushed in any case, and because of this the intervention must be of a more extensive nature, in part because it must be intradural, and in part because a larger exposure must be made. Under these conditions, postoperative back pains must be expected in a fairly large number of cases. Despite the fact that, when the operation has been performed at the Orthopedic Clinic at Stockholm, care has been taken to make the lesion in the adjoining arches as small as possible, and the spinous process has not been touched, there have been a large number of cases of back pains following the operation, viz. 8 out of 15 patients operated upon. A possible explanation might be the high average age of these patients and the comparative frequency of spondylitis deformans. In its present form the method is of limited value. Those most likely to benefit from it, if it can be improved, will in all probability be patients of a high age with advanced bilateral lesions, or those with severe lesions on the one side, upon whom it is not possible to undertake a hip operation.

Summary.

The author describes the results achieved by means of radicotomy of the third, fourth, or fifth lumbar roots in 15 cases of arthritis deformans of the hip joint. In three cases the intervention was bilateral and in the others monolateral. The results were as follows: Good in one case, satisfactory in seven, poor in six, and bad in four.

In its present form, the method is of doubtful value, and further work on its perfection is necessary.

Zusammenfassung.

Verf. teilt die Ergebnisse bei 15 Fällen von Arthritis deformans coxae mit, die mittels Radikotomie an der III., IV. oder V. lumbalen Wurzel behandelt waren. Bei 3 Fällen wurde doppel-seitige Radikotomie vorgenommen, bei den übrigen einseitige. Die erzielten Resultate waren folgende: In einem Falle gut, in 7 Fällen befriedigend, in 6 Fällen weniger befriedigend und in 4 Fällen schlecht.

Die Methode ist in ihrer jetzigen Form von sehr beschränktem Wert und muss weiter ausgearbeitet werden.

Résumé.

L'auteur décrit les résultats de 15 cas de l'arthrite déformante de la hanche, traités par radicotomie à la III, IV, ou V racine lombaire. En 3 cas radicotomie bilatérale a été performée, dans les autres unilatérale. Les résultats obtenus ont été les suivants: en 1 cas, bon, en 7 cas, satisfaisant, en 6 cas, moins satisfaisant et en 4 cas, mauvais.

La méthode a, dans sa forme présente, une valeur très limitée, et doit être encore perfectionnée.

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From the Surgical Clinic in Lund
(Chief: Prof. J. P. STRÖMBECK, M. D.),
and the Institute of Medical Chemistry in Lund
(Chief: Prof. E. M. P. WIDMARK, M. D.).

On the Prothrombin Index in Acute Affections of the Pancreas.

By

STIG BORGSTRÖM.

If the prothrombin index in the blood is followed on a clinical material with the QUICK-LEHMANN micro-method (1941) abrupt decreases will be found from time to time, which in all probability cannot be due to a change in the vitamin K content of the body or to its ability to form prothrombin. STRÖMBECK (1941) was the first to observe a decrease of the prothrombin index simultaneous with an increased diastase value. He writes: "Eine isolierte Beobachtung einer leichten Protrombinsenkung auf 60 bzw. 63 % bei akuter Pankreatitis 2 bzw. 4 Tage nach Krankheitsbeginn sei ferner verzeichnet. Es bestand kein Ikterus, die Diastasezahl war nach 1 Tage 8 912. 9 Tage nach Krankheitsbeginn war der Protrombinindex 100." A similar observation has been made in a patient operated according to Billroth 2 for chronic, callous ventricular wound. On the 6th day after the operation the prothrombin index fell from the earlier, normal value to 51 and remained there for 24 hours, to rise again on the 8th day after operation to 96. At the same time the diastase value in the urine rose to 2 048 (from 32), to fall again to the normal value 256 on the 8th day after operation. The operation had been performed with lumbar anaesthesia, which does not as a rule give any postoperative decrease of the prothrombin index (BORGSTRÖM 1943). In 18 patients who have come to the Surgical Clinic with acute biliary attacks and increased diastase value in the urine, the prothrombin index has most often been found to be decreased. The mean value of the

prothrombin index was 77 ± 2.3 . If this value is compared with the mean prothrombin index, determined before operation in 101 patients, 89 ± 1.8 (BORGSTRÖM 1943), a statistically significant lower index in the biliary attacks is found (12 ± 2.9 ; $\sigma = 4.1$). It is difficult to assume any sudden change in the patient's vitamin K or his ability to form prothrombin, and the reason for the decrease will have to be sought elsewhere.

KRAUL (1941) is of the opinion that the reason why the menstrual blood does not clot is a lack of fibrinogen. This lack of fibrinogen is in its turn caused by a trypsin-like enzyme present in the endometrium, which breaks up the fibrinogen in the menstrual blood. The question arises whether a similar mechanism might not be acting in the blood-vascular system in cases of increased diastase. The diastasuria in cases of gallstone is caused by diastase from the pancreas passing out into the blood when the gallstone prevents the pancreatic juice from emptying into the duodenum. As diastase passes from the pancreatic cells into the blood, it seems highly probable that under similar circumstances the protein-converting enzymes pass the same way. The shock effect, observed in severe cases of acute pancreatitis, is also considered due to an outflow of enzymes, in the first place trypsin, into the blood. The first question is thus how the prothrombin index is influenced when the amount of trypsin in the blood increases. This question can also be put as follows: Does an increase of the amount of trypsin in the blood lower the prothrombin index?

The Prothrombin Index after Injection of Trypsin into the Blood-Vascular System.

In order to investigate the influence on the prothrombin index of trypsin, injected into the blood-vascular system, 5 female rabbits were chosen for the experiments. Each of them weighed about 1.5 kg. A blood sample was taken from each animal by means of heart puncture, as for sedimentation reaction; four parts blood were thus diluted with one part natrium citrate solution. The prothrombin was determined according to QUICK-LEHMANN (1941) at least 3 times for each sample. The clotting time for the different animals differed by some seconds at most. The mean value thus obtained for each animal was taken as norm, and a

prothrombin index corresponding to this coagulation time was put at 100.

After this the following solutions were injected into the ear veins of the animals:

Animal no.	1	10 ml 0.9 % NaCl-solution
»	2	0.10 g trypsin ("Merck") dissolved in 10 ml 0.9 % NaCl-solution
»	3	0.25 g trypsin ("Merck") dissolved in 10 ml 0.9 % NaCl-solution
»	4	0.5 g trypsin ("Merck") dissolved in 10 ml 0.9 % NaCl-solution
»	5	1.0 g trypsin ("Merck") dissolved in 10 ml 0.9 % NaCl-solution.

Animal no. 1 acted as a control. Blood samples, collected in the way mentioned above, were then taken from each animal $\frac{1}{2}$, 1, 2 and 3 hours after the injection. The prothrombin was determined and the index calculated. The figures obtained are seen from fig. 1. All the animals survived and seemed to be quite all right after the experiment.

The curves in fig. 1 show that the injection of physiological salt solution and the collection of blood samples at all events do not lower the prothrombin index. The slightly increased prothrombin index of animal no. 1 should be within the limits of error. Nor does it seem as if a small dose of trypsin (animal no. 2) had any influence on the prothrombin value. If, on the other hand, the amount of trypsin injected into the blood-vascular system is increased, the decrease of the prothrombin index becomes more and more pronounced. At the highest dose, 1.0 g, it has after 2 hours sunk to less than 1. *It has thus been shown that an increase of the trypsin content of the blood may lower the prothrombin index.*

In order to investigate whether the reticulo-endothelial system has any influence on the ability of the trypsin to lower the prothrombin index, the preceding experiment was repeated. Three other female rabbits, weighing about 1.5 kg, were chosen. All of them were first treated with trypan blue to block the reticulo-endothelial system, if possible. They were thus given intravenous injections of 4 ml trypan blue, diluted to 0.5/1 000, 5, 3 and 1 days, and also 4 hours, before the experiment. The experiment was then performed in the same way as the one mentioned earlier. Thus, animal no. 1 only got an intravenous injection of

10 ml 0.9 % NaCl-solution, while animals no. 2 and 3 got respectively 0.25 g and 0.5 g trypsin, dissolved in 10 ml physiological salt solution. The results of the prothrombin determinations are seen from fig. 2. A very slight tinge of blue was perceptible in the serum from all the animals, which led to the conclusion that the reticulo-endothelial system was blocked at least to a certain degree.

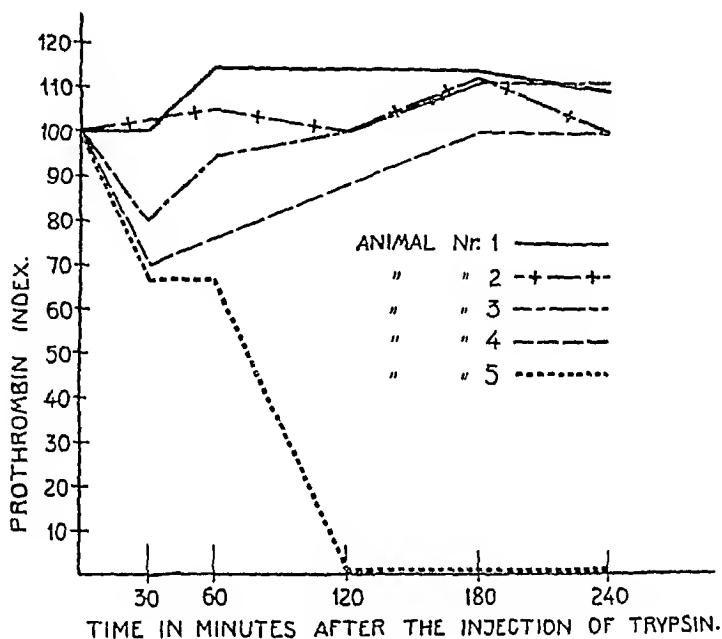


Fig. 1.

If the corresponding curves from figs. 1 and 2 are compared, relatively good agreement is found. The initial treatment of the animals with trypan blue does not seem to have materially influenced the ability of the trypsin to lower the prothrombin index.

When trypsin is injected into the blood-vascular system a certain digestion of the blood proteins should be expected and, if this digestion proceeds sufficiently, an increase of the non-protein nitrogen. From a rabbit, weighing 1.5 kg, which had been injected with 0.75 g trypsin diluted in 10 ml physiological salt solution, 1 ml heart blood was taken at the same time as the sample for the prothrombin determination, in order to determine the non-protein nitrogen (according to OHLSSON, 1937). The trypsin has been manufactured by "Mercks" this time, too, although from a new consignment. The effect was stronger than in the first experi-

ment, and the prothrombin index sank to less than 1 as early as 30 minutes after the injection of trypsin. It still remained on this low level when tested after 1, 2 and 3 hours. The non-protein nitrogen, which according to double determinations before the injection of trypsin was 27 mg %, rose after 30 minutes to 31 mg % and was, when tested after 1, 2 and 3 hours, 28, 29 and 28 mg % respectively.

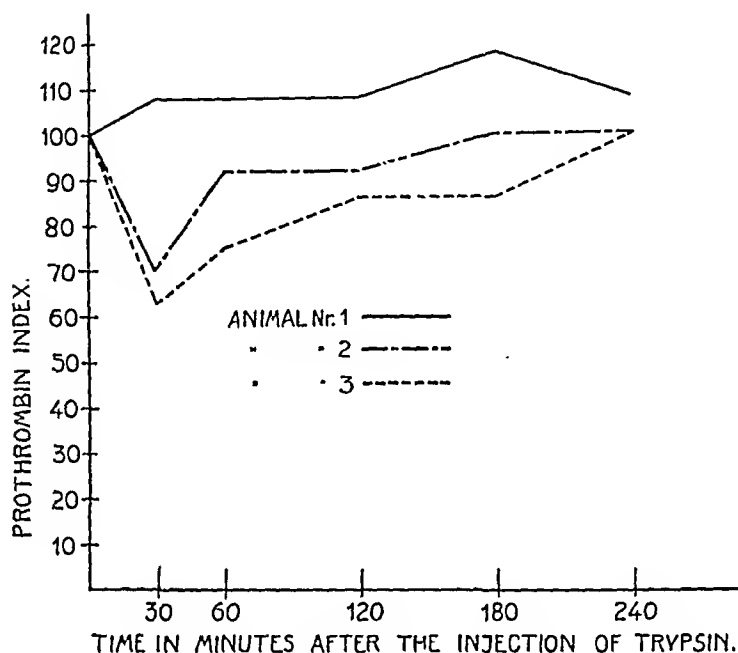


Fig. 2.

In spite of the slight increase of the non-protein nitrogen value from 27 mg % to 31 mg % half an hour after the injection of trypsin, the non-protein nitrogen can be considered to have remained practically unchanged. The only conclusion to be drawn from this is that if the blood proteins are broken up, no lower products remain in the blood-vascular system.

The Fibrinogen Index after Injection of Trypsin into the Blood-Vascular System.

When it has been established that trypsin in the blood-vascular system lowers the prothrombin index, the question remains: Where in the coagulation process does trypsin intervene? Fig. 3 represents the most generally accepted coagulatory course.

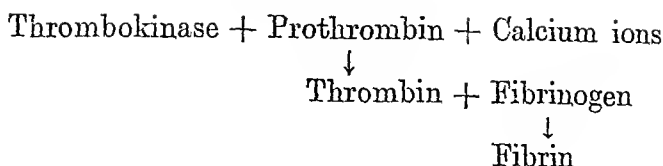


Fig. 3.

When determining the prothrombin time thrombokinase and calcium ions are added to citrate blood or citrate plasma. The clotting time will then vary with the amount of prothrombin, always assuming that the amount of fibrinogen remains constant. This assumption is always made and will, moreover, generally prove true. But does this assumption also hold good when the amount of trypsin in the blood-vascular system has increased? The following method has been used to investigate the amount of fibrinogen in the blood. It is based on the same principles and carried out in the same way as the prothrombin determination according to QUICK-LEHMANN. In this case, however, a thrombin solution only is added to citrate blood, and the clotting time is then measured. This time will then depend solely on the amount of fibrinogen in the sample (see fig. 3).

Method: A thrombin solution is obtained by dissolving thrombin ("Leo") in physiological salt solution. By means of tests on normal blood the dilution of the thrombin solution is regulated so that the clotting time of the blood in the procedure mentioned below is between 20 and 25 seconds. This thrombin solution does not keep for more than one or two hours. A blood sample is taken as in the prothrombin determination method according to QUICK-LEHMANN, either as for a sedimentation rate, or by puncture of the fingertip, in the latter case with a 0.1 ml pipette, in which 3.8 % sodium citrate solution has first been drawn up by suction to 1/5 of the volume of the pipette. 0.1 ml citrate blood is then transferred to a centrifuge tube and put in a water bath at 37° C. 0.1 ml of the thrombin solution is added, and the centrifuge tube gently agitated in the water bath. The time from the introduction of the thrombin solution into the blood sample to the clotting of the latter is read off on a stop watch.

The fibrinogen index is then obtained $= \frac{a \cdot 100}{b}$.

a = the clotting time for normal blood

b = » » » » the test sample.

The fibrinogen index has, when determined in a number of healthy persons, been found to lie between 90 and 110.

If citrate blood is diluted with physiological salt solution and the fibrinogen index calculated, the curve seen in fig. 4 is obtained.

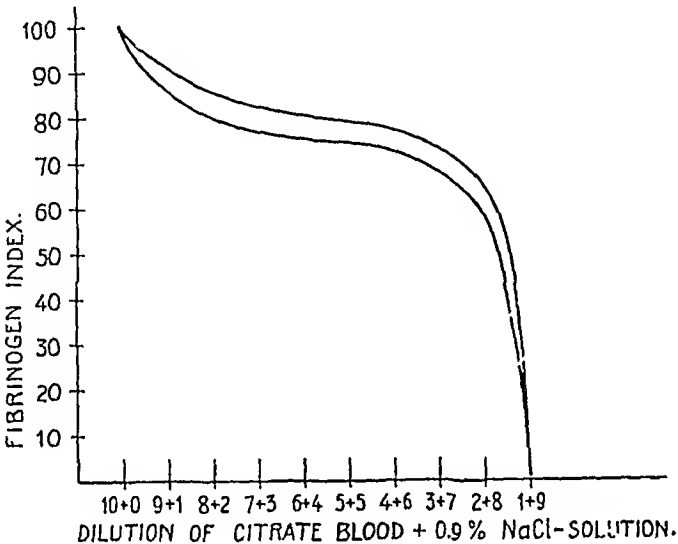


Fig. 4.

With the method given above simultaneous determinations of the fibrinogen and the prothrombin index have been made in rabbits, which had been given intravenous injections of trypsin. The course of the experiment was the same as in the ones mentioned earlier. The results were uniform, and only one experiment is given here by way of example. It comprised 3 animals, one control animal and two, which were given intravenous injections of 0.75 and 1.0 g trypsin respectively in physiological salt solution. The values obtained are seen in table 1. After 30 minutes both prothrombin index and fibrinogen index were found to have sunk to less than 1. *An increased amount of trypsin in the blood-vascular system thus lowers the amount of fibrinogen in the blood.*

Table 1.

Rabbit nr	Prothrombin index (P ind)	Fibrinogen index (F ind)	Trypsin in g intra- venously	Time after injection			
				30 min		60 min	
				P ind	F ind	P ind	F ind
I	100	100	0	105	107	100	105
II	100	100	0.75	<1	<1	<1	<1
III	100	100	1.00	<1	<1	<1	<1

A decrease of the amount of fibrinogen as large as that found in the last-described experiment ought also to explain the lowered prothrombin indices that were observed. There is, however, a possibility that trypsin may also influence the prothrombin. It should be possible to ascertain this by repeating the last experiment and adding fibrinogen to the samples.

Fibrinogen was obtained by precipitation of citrate plasma. This was saturated to 1/5th with ammonium sulphate. The precipitate was centrifuged, separated off, dissolved in physiological salt solution and again precipitated twice. A jelly-like, white-yellow product was obtained, which was used in a moist, fresh state. It lost its power of solubility when dried. About 100 mg of this moist product, dissolved in 1 ml physiological salt solution showed, at the determination of the prothrombin, a clotting time of $= \infty$, the prothrombin index thus being less than 1. When determining the fibrinogen index the clotting took about twice as long as in the corresponding determination of normal blood.

The following experiment was performed with the fibrinogen-rich product thus obtained. Three female rabbits were used. Two samples of 1 ml citrate blood were taken from each of them by heart puncture. About 100 mg of the above described fibrinogen-rich product was dissolved in one of the samples from each animal. The prothrombin and fibrinogen indices were then determined for all the samples. After that, rabbit no. 1 was injected intravenously with 10 ml physiological salt solution, while the other two were injected with 0.5 and 0.7 g trypsin respectively, dissolved in physiological salt solution. 30 minutes after these injections two samples were again taken from each animal by heart puncture, and treated like those taken earlier. The results are outlined in table 2. It is seen from the control animal that the prothrombin index remained constant. Thus this index was not influenced by the added fibrinogen. Neither was there any marked change of the fibrinogen index in the control animal. On the other hand, those animals, which were given trypsin injections showed a decrease of both the prothrombin and the fibrinogen index. This latter index could, however, be normalized by the addition of fibrinogen, while the prothrombin index remained practically unchanged. Thus, the conclusion to be drawn from this experiment is that *both the fibrinogen and the prothrombin content of the blood decrease when the amount of trypsin in the blood-vascular system increases.*

Table 2.
Experiments on rabbits.

Animal Nr	Index	Before injection		30 min after injection	
		Without fibrinogen	With fibrinogen	Without fibrinogen	With fibrinogen
I Injection of 10 ml 0.9 % NaCl	Prothrombin Fibrinogen	100 100	107 96	103 94	100 92
II Injection of 0.5 g trypsin in 10 ml 0.9 % NaCl	Prothrombin Fibrinogen	100 100	99 98	62 63	67 111
III Injection of 0.7 g trypsin in 10 ml 0.9 % NaCl	Prothrombin Fibrinogen	100 100	98 101	50 38	54 97

If a patient with biliary attacks presents both increased diastasia and lowered prothrombin index, this latter decrease may thus be explained by an increase of the trypsin content in the blood, with the ensuing destruction of both prothrombin and fibrinogen. If this is true the fibrinogen values in the blood should be higher when the patient has recovered than during the acute attack. The following experiments show that such may be the case, too.

In 3 patients with typical, acute biliary attacks, a diastasia of >2048 and a prothrombin index of 72—83, the amount of fibrinogen in the blood was determined (precipitation of the fibrinogen to fibrin and wet ashing) both immediately on admittance to hospital and a week or so later, when the diastase values and the prothrombin index had returned to normal. None of the patients had been operated upon in the meantime. The fibrinogen values obtained were respectively 11, 22 and 32 % lower during the acute attack than later, when the attack had subsided. These experimental results agree with the assumption that one or more of the components in the clotting process of the blood are subjected to some influence during the biliary attacks. It is known for certain that both diastase and lipase pass out into the blood-vascular system in greater quantity during the attack. The values here obtained well bear out the assumption that trypsin, too, flows out. *With the support of animal experiments it can thus with very great probability be maintained that the rapid decrease of pro-*

thrombin, observed together with increased diastasuria in acute pancreatic affections, is due to trypsin's passing out into the blood-vascular system and to the influence of trypsin on the prothrombin and the fibrinogen.

This investigation has been carried out with the support of the K. Fysiografiska Sällskapet i Lund, for which I beg to offer my sincere thanks.

Summary.

STRÖMBECK (1941) was the first to observe a decrease of the prothrombin index at the same time as an increased diastasuria. This observation has here been verified on a somewhat larger material (18 cases).

If, in acute affections of the pancreas, trypsin — like diastase — were to pass out into the blood-vascular system, an enzymatic influence of the trypsin on prothrombin or fibrinogen or both might be assumed, thus explaining the lowered prothrombin index.

Experiments on rabbits show that trypsin, injected into the blood-vascular system, gives a decrease of both the prothrombin and the fibrinogen content of the blood.

The prothrombin content has here been determined according to QUICK-LEHMANN. The author has worked out a similar method for the determination of fibrinogen, by which the clotting time could be determined after the addition of thrombin to citrate blood. The fibrinogen index is obtained by comparison with the clotting time in normal blood, arrived at by the same method.

Determinations have been made on 3 patients with acute biliary attacks. The diastasuria during the attack was >2048 , and the prothrombin index 72—83. Simultaneous determination of the amount of fibrinogen showed values lower than those obtained when the attack had subsided and the increased diastasuria ceased, and the prothrombin index had returned to normal. With the support of animal experiments it can with very great probability be maintained that the rapid decrease of prothrombin, observed together with increased diastasuria in acute pancreatic affections, is due to the passage of trypsin out into the blood-vascular system, and to the influence of trypsin on the prothrombin and the fibrinogen.

Zusammenfassung.

STRÖMBECK (1941) hat als erster ein Sinken des Prothrombinindex bei gleichzeitig erhöhter Diastasurie beobachtet. Diese Beobachtung wurde hier an einem etwas grösseren Material (18 Fällen) bestätigt.

Wenn Trypsin — wie auch Diastase — bei akuter Pankreasaffektion in das Blut übertritt, kann man sich eine enzymatische Beeinflussung des Prothrombins oder Fibrinogens durch das Trypsin denken und hierin eine Erklärung für den herabgesetzten Prothrombinindex finden.

Versuche an Kaninehen zeigen, dass in die Blutbahn gebrachtes Trypsin ein Sinken sowohl des Prothrombin- als auch des Fibrinogengehaltes des Blutes hervorruft.

Der Prothrombingehalt wurde hierbei nach QUICK-LEHMANN bestimmt. Für die Bestimmung des Fibrinogens hat Verf. eine ähnliche Methode ausgearbeitet, bei der man nach Zusetzen von Thrombin zum Zitratblut die Gerinnungsgeschwindigkeit bestimmt. Den Fibrinogenindex erhält man durch Vergleich mit der Gerinnungszeit für Normalblut, die mit der gleichen Methodik gefunden wurde.

Es wurden an drei Patienten mit akutem Gallensteinanfall Versuche angestellt. Während des Anfalls betrug der Diastasegehalt des Harns $> 2,048$ und der Prothrombinindex 72—83. Gleichzeitige Bestimmung des Fibrinogengehaltes ergab Werte, die niedriger lagen als die nach Abklingen des Anfalles, Aufhören der erhöhten Diastaseausscheidung im Harn und Normalisierung des Prothrombinindex erhaltenen. An Hand der vorgenommenen Tierversuche dürfte man mit grosser Wahrscheinlichkeit behaupten können, dass das bei akuter Pankreasbeeinflussung gefundene schnelle Sinken des Prothrombins bei gleichzeitig vermehrter Diastasurie durch eine Ausschwemmung von Trypsin in die Blutbahn und Beeinflussung des Prothrombins und des Fibrinogens durch das Trypsin bedingt ist.

Résumé.

STRÖMBECK (1941) le premier a observé un abaissement de l'index de la prothrombine allant de pair avec une élévation de la diastasurie. Cette observation a été confirmée ici sur un matériel un peu plus grand (18 cas).

Si la trypsine — comme la diastase — passe dans le sang à l'occasion d'une affection aiguë du pancréas on peut penser à une action enzymatique de la trypsine sur la prothrombine ou le fibrinogène, ou bien sur les deux, et y trouver une explication de l'abaissement de l'index de la prothrombine.

Des expériences sur les lapins montrent que la trypsine introduite dans la voie sanguine provoque un abaissement de la teneur du sang aussi bien en prothrombine qu'en fibrinogène.

La teneur en prothrombine a été, en l'occurrence, déterminée d'après la méthode de QUICK-LEHMANN. Pour doser le fibrinogène l'auteur a mis au point un procédé semblable, selon lequel après adjonction de thrombine au sang citraté on mesure la vitesse de coagulation. L'index du fibrinogène s'obtient par comparaison avec le temps de coagulation du sang normal, trouvé par la même méthode.

Des essais ont été faits chez trois malades en crise aiguë de cholélithiase. Pendant l'accès le chiffre des diastases dans l'urine était de $> 2,048$ et l'index de la prothrombine de 72—83. Une détermination concomitante de la teneur en fibrinogène donna des chiffres inférieurs à ceux obtenus après que l'accès se fut terminé, que l'élimination exagérée de la diastase par les urines eut cessé et que l'index de la prothrombine fut redevenu normal. En se basant sur les essais faits sur les animaux on peut donc soutenir avec grande vraisemblance que la rapide chute de la prothrombine, qui dans les affections aiguës du pancréas s'observe en même temps que l'augmentation de la diastasurie, est due à un passage de la trypsine dans la voie sanguine ainsi qu'à son action sur la prothrombine et le fibrinogène.

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Plastischer Ersatz des M. sphincter ani.

Von

O. BISTRÖM.

Eines der quälendsten Leiden, von denen ein Mensch betroffen werden kann, ist die Fäkalinkontinenz. Wie bekannt, kann dieser Zustand auf Grund mehrerer verschiedener Ursachen entstehen. Einerseits kann er nach Operationen im Analgebiet zustandekommen, andererseits nach Traumen, ferner nach verschiedenen Krankheitszuständen wie z. B. Rektalprolapsen, Entzündungen, Tumoren u. s. w. und schliesslich bei Nervenkrankheiten und zwar in erster Linie bei solchen, die im Rückenmark lokalisiert sind.

Ganz besonders bedrückend ist die Inkontinenz für die Psyche. Das ständige Gefühl der Unsauberkeit und das Bewusstsein, seine Umgebung durch den abstossenden Geruch zu plagen, macht den Inkontinenten völlig asozial. Deshalb ist es natürlich, dass im Laufe der Zeit zahlreiche verschiedene Methoden zur Rettung dieser Individuen für die Gesellschaft vorgelegt worden sind.

Wenn man diese Methoden genauer betrachtet, so hat man einerseits diejenigen, die in dem Bestreben der Wiederherstellung eines geschädigten Sphinkters zur Anwendung gekommen sind, und andererseits die, die darauf ausgingen, einen aus der einen oder anderen Ursache völlig zerstörten Sphinkter zu ersetzen. Im folgenden wird nur der letztere Fall behandelt werden. Der Sphincter ani kann durch grosse Traumen völlig zerstört werden, und von diesen besitzen die Kriegsverletzungen zur Zeit die grösste Aktualität. Vollständig ist der Sphinkter auch entfernt, wenn das Rektum auf Grund eines malignen Tumors exstirpiert oder amputiert worden ist. In allen diesen Fällen ist die normale Analöffnung dann gewöhnlich durch einen operativ hergestellten Anus einen sog. Anus praeternaturalis ersetzt worden.

Bei der Versorgung eines *Anus praeternaturalis* hat man Pelotten und mit Behältern versehene Bandagen verschiedener Art verwendet. Dieselben sind auch zu der Vollkommenheit entwickelt, die man auf diesem Gebiet überhaupt zu erreichen vermag. Obwohl also hinsichtlich dieser Apparate eine unerhörte Verbesserung zustandegebracht worden ist, bleiben doch natürlich mehrere schwerwiegende Ungelegenheiten zurück. Die schädliche Einwirkung eines *Anus praeternaturalis*, den sie nicht mit absoluter Sicherheit verbergen können, auf die Psyche insbesondere jüngerer Personen, das Vorkommen störender Prolapse aus demselben und ausserdem die Tatsache, dass für diarrhoische Stühle alle Bandagen insuffizient sind, hat zur Folge gehabt, dass zahlreiche Chirurgen die operative Wiederherstellung der Inkontinenz angestrebt haben.

Während einer Reihe von Jahren sind verschiedene solche Methoden von mehreren Operateuren beschrieben worden. Das Schwierige der Aufgabe, einen Muskel von der speziellen Beschaffenheit des *M. sphincter ani* zu ersetzen, einen Muskel, der sich sogar im Ruhezustand in einer gewissen Kontraktion befindet, hat bewirkt, dass alle diese Methoden noch weit vom Ideal entfernt sind. Die meisten Chirurgen haben sie denn auch vollständig aufgegeben und begnügen sich mit einem *Anus praeternaturalis iliacus*, der leicht von dem Patienten rein gehalten werden kann, und mit der bestmöglichen Bandage. Andere wie z. B. SCHMIEDEN und ROTTER mahnen jedoch zu fortgesetzten Versuchen.

SCHMIEDEN, der einen zusammenfassenden Aufsatz über diese Versuche geschrieben hat, teilt die Methoden nach dem Prinzip, mit dem die Kontinenz erreicht werden soll, in drei Hauptarten ein: 1. diejenigen, die eine »Knickung« des Darmes kurz vor seiner Ausmündung zustandebringen, 2. diejenigen, die eine Verengung der Analöffnung herbeiführen, 3. die eigentlichen Muskelplastiken.

Historik.

Alle früher erwähnten und von SCHMIEDEN eingeteilten Operationsprinzipien sind dem *Anus praeternaturalis iliacus* angepasst worden. Vorschläge in verschiedenen Richtungen sind von FRANK, GLEICH, MARRO, v. MAYER, PAYR, SCHMIEDEN, WITZEL usw. gemacht worden. Keine dieser Methoden hat jedoch zu solchen Ergebnissen geführt, dass man es der Mühe wert gehalten hätte,

sie allgemeiner anzuwenden, und sie haben heute alle am ehesten ein historisches Interesse.

Die Methoden, die im folgenden Zusammenhang von grösserem Interesse sind, sind die diejenigen, die das Zustandekommen eines kontinenten Anus in dem ursprünglichen Analgebiet angestrebt haben. Im folgenden soll kurz über dieselben berichtet werden.

Einer der ältesten Vorschläge ist derjenige BILLROTHS, den Rektumstumpf unter dem unteren Sakrumrand herumzuführen und ihn etwas weiter nach oben in die Haut einzunähen. Auf diese Art entsteht eine »Knickung« des Darmes. MANNINGER, der diese Methode angewandt hat, macht geltend, dass das Rektum nach vorn unter der »Knickung« zu einer Art Receptakulum erweitert wird, wo sich die Faeces dann ansammeln und von dem Patienten ausgespült werden können. Meistens muss jedoch nach dieser Methode eine Pelotte benutzt werden, und eine Kontinenz für diarrhoische Stühle und Flatus wird nicht erzielt.

Eine andere ältere Methode, die auch am ehesten historisches Interesse besitzt, ist die Drehung GERSUNYS. GERSUNY legte den unteren Teil des Darmes in der Ausdehnung frei, dass er ihn 180°—360° um seine Achse drehen konnte. Hierdurch wurde eine tabakbeutelartige Verengung der Darmmündung bewerkstelligt und diese in die Haut eingenäht. In diesem Fall war es also nur die Verengung, die eine relative Kontinenz liefern sollte. DELORME hatte schon früher ungefähr dasselbe durch eine Operation zu erreichen gesucht, die im Prinzip mit der Kolporaphie EMMETS übereinstimmte. GERSUNY veröffentlichte selbst einige vorzüglich gelungene Fälle nach seiner eigenen Methode. Zeitgenössische Chirurgen (v. EISELSBERG, GERSTER, PAYR, PRITS, RYDYGIER usw.), bedienten sich der Methode und fanden sie ausgezeichnet. Auch SCHMIEDEN hält dafür, dass sie manehmal sehr nützlich sein kann. Bald bemerkte man jedoch Ungelegenheiten. Einerseits war die Gersuny'sche Plastik nicht kontinent für diarrhoische Stühle, und man war meistens gezwungen, eine Pelotte zu verwenden. Andererseits drohte bei genügender Ablösung Gangrän und konnte die Drehung bei ungenügender Ablösung nicht durchgeführt werden. Nachdem diese Gesichtspunkte geltend gemacht worden waren, ist die Methode u. a. von DEMEL, POPPERT, ROTTER, WOLFF usw. allmählich vollkommen aufgegeben worden.

Schliesslich haben wir das Gebiet, wo die besten Resultate erzielt worden sind, nämlich den Ersatz des M. sphincter ani durch eine Muskelplastik. Bei diesen Plastiken ist in erster Linie der M.

glutaeus maximus, aber auch der M. levator ani zur Anwendung gekommen.

WILLEMS, der als erster die Kontraktion des M. glutaeus maximus als Ersatz zu benutzen versuchte, zog den abgelösten Darm durch ein in der Faserrichtung des M. glutaeus maximus stumpf gebohrtes Loch und vernähte ihn hierauf mit der Haut. RYDYGIER schlug nach Leichenversuchen zuerst vor, den Darm durch ein stumpf hergestelltes Loch im M. pyriformis und erst dann durch den M. glutaeus maximus und die Haut zu ziehen. v. EISELSBERG gibt an, in zwei nach RYDYGIER in Kombination mit der Gersuny'schen Drehung operierten Fällen gute Erfolge gehabt zu haben.

Im Jahre 1900 publizierte LENNANDER eine relativ komplizierte Analplastik, wobei er Muskelplatten vom M. levator ani verwendete.

Im Jahre 1902 brachte CHERWOOD einen Fall von Incontinentia ani heraus, der nach einem ganz neuen Prinzip operiert worden war. Von dem medialen Rand des M. glutaeus maximus wurde auf beiden Seiten ein Lappen von ungefähr 2 cm Breite abgetrennt. Die Insertionspunkte der Lappen am Sakrum wurden intakt gelassen. Die Lappen wurden hinter dem Rektum gekreuzt und jeder auf seiner Seite desselben herabgezogen sowie vor ihm vernäht.

SCHOEMAKER änderte diese Plastik i. J. 1909 dahin ab, dass der eine Lappen vorn, der andere hinten um das Rektum herumgeführt wurde, worauf sie so vernäht wurden, dass sie einen Ring um das Rektum bildeten. SCHOEMAKER gibt selbst an, dass er hierdurch eine vollständige Kontinenz auch für leicht flüssige Faeces erreichte. Die Methode wurde später z. B. von KATHOLICKY und FRANGENHEIM angeblich mit Erfolg angewandt. SCHMIEDEN dagegen ist der Ansicht, dass sie bei weitem nicht ideal ist. Er hebt hervor, dass die von der Plastik zustandegebrachte Wirkung, da die Innervation zu dem Lappen nach der Beschreibung der Methodik aufgehoben sein muss, lediglich auf einer Narbenstriktur beruhen kann.

WELCKE benutzt nur den linksseitigen M. glutaeus maximus, von dem Stumpf ein 6 cm breiter Abschnitt unter Beibehaltung von dessen Insertionspunkten abgelöst wird. Der erwähnte Muskelabschnitt wird gespalten und die zwei erhaltenen Teile werden gekreuzt. Zwischen diesen gekreuzten Schenkeln wird dann das Rektum hindurchgezogen und mit der Haut vernäht. WELCKE ist der Ansicht, dass er hierdurch eine gewisse konstante Span-

nung erreicht, die die Analöffnung kontrahiert hält, und die durch bewusste Kontraktion weiterhin vergrössert wird.

BROWN operiert nach der Methode Schoemakers, benutzt aber den *M. levator ani* anstatt des *M. glutaesus maximus*.

GOEBELL hat, ausgehend davon, dass bei den Methoden Schoemakers und Chetwoods keine Rücksicht auf die Innervation und die Blutgefässversorgung der Lappen genommen wird, ein eigenes Verfahren ausgearbeitet. Er verwendet die mittelste Portion des *M. glutaesus maximus* auf beiden Seiten. Dieselbe wird stumpf abgelöst und von ihrem Insertionspunkt am Trochanter major abgetrennt. Nerven und Blutgefässe werden sorgfältig geschont. Hierauf werden die Sehnen der beiden Seiten jede auf ihrer Seite des Rektums herabgeführt und vor demselben vernäht. Bei der Kontraktion drücken sie das Rektum gegen den Sakralrand zusammen. Zur Verstärkung der Wirkung änderte er die Methode später dahin ab, dass ausserdem ein Faszientransplantat hinter dem Rektum eingenäht wurde. Falls die mittelste Portion des *M. glutaesus maximus* nicht ausreicht, kann seines Erachtens auch der *M. adductor longus* benutzt werden.

WREDE und STONE gebrauchen Fasziensehlingen. Die Sehlingen umgeben den Anus ringförmig und werden jede für sich auf ihrer Seite an dem betreffenden *M. glutaesus maximus* befestigt, dessen Kontraktion die Sehlinge dann auf die Analöffnung überträgt. Stone hat 11 Fälle veröffentlicht, von denen 5 angeblich vorzüglich gelungen waren.

MATAS und FERRANINI verwenden ebenfalls Lappen aus dem *M. glutaesus maximus*. Dieselben werden hinter dem Rektum gekreuzt und vor ihm vernäht. IZQUIERDO nimmt Lappen vom *M. levator ani* und näht sie nach der andern Seite hinüber. Dann zieht er das Rektum durch das zwischen ihnen entstandene Loch.

Schliesslich hat ZAHRADNICEK i. J. 1927 eine Analplastik publiziert, wobei vom *M. glutaesus maximus* auf beiden Seiten ein Lappen von 6—3 cm Breite freiprepariert wird. Um die Innervation beizubehalten, sind die Lappen lateral gestielt. In dem Lappen wird eine knopflochähnliche Öffnung angebracht. Die Lappen werden übereinandergenäht und das Rektum durch das Loch gezogen und mit der Haut vernäht. ZAHRADNICEK hat selbst nur einen publizierten Fall operiert, der angeblich sowohl für Faeces als für Flatus kontinent wurde.

Aus dieser Übersicht ersieht man, dass die Entwicklung dahin geführt hat, dass man heutzutage eine Muskelplastik anstrebt,

und dass in erster Linie der *M. gluteus maximus*, aber möglicherweise auch der *M. levator ani* in Frage kommt. Im übrigen bestehen die Forderungen bei einer derartigen Muskelplastik nach ROTTER darin, dass die Muskeln den Anus ringförmig umgeben und dass sie Insertionspunkte haben. Als besonders wichtig gilt es, dass die Innervation des Muskels beibehalten bleibt.

Methodik. (Fig. 1 u. 2.)

In der chirurgischen Abteilung der Diakonissenanstalt in Helsingfors hat Prof. F. LANGENSKIÖLD eine Methode angewandt, die im grossen Ganzen mit der obigen von ZAHRADNICEK publizierten Methode übereinstimmt. Die Methode ist bei zwei traumatischen Fällen sowie nach einer Rektumamputation zur Anwendung gekommen.

Die Operation beginnt mit dem Ausschneiden der Narbe in der ursprünglichen Analgegend in der *Crena ani*. Danach wurde der Rektumstumpf vorsichtig herauspräpariert und so hoch abgelöst, dass man ihn ohne Spannung bis in die Hautwunde herabziehen konnte. Der mediale Rand des *M. gluteus maximus* wurde auf beiden Seiten freigelegt. Dieser Muskel wurde in einer Breite von 3—5 cm von seiner Insertion am *Os occygeum* und *Os sacrum* losgetrennt. Ein Lappen von dieser Breite wurde dann zu beiden Seiten durch stumpfes Ablösen des medialen Randes in der Faserichtung, ausgehend vom Sakrum, in einer Ausdehnung von zwei Dritteln der Muskellänge gebildet. Die Ablösung ist vorsichtig und so weit möglich ohne Durchschneidung von Nervenbahnen erfolgt. Der erhaltene Lappen ist distal im Zusammenhang mit dem unteren Teil des Glutäalmuskels geblieben.

In beiden Lappen ist dann in der Faserrichtung ein knopflochähnliches Loch von ungefähr 2—3 cm Länge gesetzt worden. Der herauspräparierte Rektumpstumpf ist durch dies Loch gezogen worden, wobei die Lappen mit einigen Katgutnähten übereinander fixiert wurden. Schliesslich ist die Mündung des Darmstumpfes mit Seide in die Haut eingenäht und die Hautwunde mit dem gleichen Material geschlossen worden. In den unteren Wundwinkel wurde ein dünnes Gummidrain eingelegt.

Die erhaltene Öffnung hat gleich nach der Operation eine Weite von etwa Fingerdicke gehabt. Um einer eventuellen Narbenschrumpfung entgegenzuwirken, wurde schon einige Tage nach

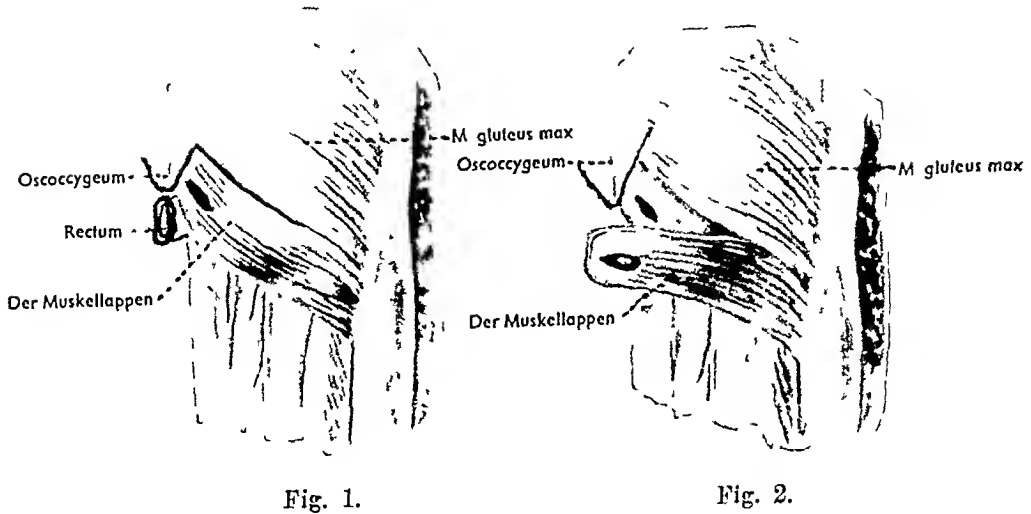


Fig. 1.

Fig. 2.

der Operation eine methodische vorsichtige Dilatation der neuen Analöffnung eingeleitet. Der Patient wurde sogleich ermahnt, sich im Zusammenziehen seiner neuen Analöffnung mittels Glutäalmuskelkontraktionen zu üben. Die Kontraktion hat sich auch von Anfang an als sehr gut erwiesen.

Wenn die Wunde dann verheilt war, ist der Anus præternaturalis iliacus in einer späteren Sitzung in üblicher Weise geschlossen worden.

Kasuistik.

Fall I. F. V. 66 J. Landwirt. Früher im allgemeinen gesund. 1935 allmählich zunehmende Schmerzen bei der Stuhlentleerung. Oft Schleim und zeitweise Blut per rectum. Verdauung sehr träge. Kam im Juli 1935 nach Helsingfors, wo Mastdarmkrebs konstatiert und die Amputatio recti ausgeführt wurde. Der Rektumstumpf wurde gleich unter dem Sakrum in die Haut eingenäht und ein Anus præternaturalis iliacus angelegt. Der Allgemeinzustand des Patienten besserte sich danach rasch. Die Beschwerden verschwanden, er hatte guten Appetit und nahm an Gewicht zu.

Da sich der Patient durch seinen Anus præternaturalis stark belästigt fühlte, kam er am 25. 2. 1936 in die Diakonissenanstalt zu Helsingfors. Damals wurde bei der Untersuchung festgestellt: Allgemeinzustand relativ gut. Subkutanes Gewebe jedoch deutlich reduziert. Herztöne dumpf, aber regelmässig und gleichmässig. Lungen o.B. In der linken Iliakalregion öffnet sich eine Darmfistel, aus der die Darmenden prolabieren. Die ursprüngliche Analöffnung ist geschlossen, und der Darm öffnet sich hinten direkt unter dem Os sacrum. Der Stuhl kommt ausschliesslich durch den Anus iliacus, durch den Anus sacralis kommt nur etwas Schleim.

Dem Patienten wurde eine Analplastik vorgeschlagen, aber er war unschlüssig und begab sich nach Hause. Kam am 25. 9. 1936 mit im grossen Ganzen unverändertem Status wieder und war nun zur Operation bereit. Karzinomrezidive konnten nicht festgestellt werden.

Am 25. 9. 1936 wurde in Lumbalanästhesie eine *Sphinkterplastik* ausgeführt. Schnitt in der Mittellinie vom Perineum nach hinten um den Anus sacralis herum. Mit einem umgebenden Hautrand von 5 mm Breite wird der Anus sacralis von der Umgebung gelöst und das Rektum vorsichtig freigelegt. Hierbei wird die Peritonealhöhle eröffnet. Das Peritoneum wird vom Rektum abgelöst und die Peritonealhöhle dadurch geschlossen, dass man das Peritoneum weiter oben am Rektum annäht. Hierauf wird vom medialen Rand des *M. glutaeus maximus* zu beiden Seiten ein 5 cm breiter Muskellappen freipräpariert. Die Lappen werden vom Sakrum abgelöst und bleiben distal an dem Glutäalmuskel fixiert. In beiden Lappen wird eine Öffnung von ein paar cm Länge gesetzt und das Rektum durch diese Löcher gezogen. Die Lappen werden mit einigen Katgutnähten übereinander befestigt. Die Wunde wird geschlossen, wobei die tiefen Schichten mit Katgut und die Haut mit Seide vernäht wird. Der Anus sacralis wird mit Seide 5 cm vor seiner früheren Mündungsstelle in die Haut eingenäht. In den hinteren Wundwinkel wird ein Drain eingelegt.

Die Wunde heilte gut, und zwei Wochen später wurde die Dilatation der neuen Analöffnung eingeleitet. Die Dilatation gelang gut. Der Anus präternaturalis wurde am 23. 11. 1936 geschlossen.

Eine Woche nach der Operation konnte man feststellen, dass der neue Analmuskel gut funktionierte. Wenn man einen Finger in den Anus einführte und den Patienten aufforderte, diesen zu kontrahieren, griffen die Muskelschenkel kräftig um den touchierenden Finger an. Beim Herannahen des Stuhls wurde der Patient diesen gewahr und konnte den Stuhl nun durch die Kontraktion zurückhalten, bis er einen Abort erreichte.

Nachuntersuchung am 11. 1. 1944. Etwa von der Mitte des Os sacrum bis herab zum Perineum erstreckt sich eine 15 cm lange Narbe. Ungefähr in der Mitte dieser Narbe etwas näher am Perineum befindet sich die jetzige Analöffnung. Dieselbe ist für 2 Finger durchgängig. Wenn der Patient aufgefordert wird, die Analöffnung zu kontrahieren und hierbei die Glutäalmuskeln spannt, fühlt man in der Analöffnung in etwa 1½ cm Tiefe zwei Querfalten, die die Analöffnung völlig verschliessen. Ein Karzinomrezidiv kann nicht festgestellt werden.

Der Patient gibt an, er habe deutliche Sensationen, wenn der Stuhl in den Mastdarm herabkommt. Er wird nachts hierdurch geweckt. Durch die Kontraktion der Glutäalmuskulatur kann er dann sowohl festen als auch flüssigen Stuhl zurückhalten, bis er einen Abtritt erreicht. Meint, er könne eine gute Kontraktion

wenigstens 10 Minuten aufrechterhalten. Gibt an, er könne auch Flatus zurückhalten, wenn er sich in Ruhe befindet. Wenn sich Patient in Bewegung befindet, geht jedoch der Flatus oft unfreiwillig ab.

Patient ist mit seinem gegenwärtigen Zustand sehr zufrieden und kommt nach seiner Meinung jetzt viel besser zurecht als mit seinem früheren Anus iliacus.

Fall II. V. T. M. 41 J. Landwirt. Dem Patienten wurde am 13. 8. 1941 ein schweres Trauma in der linken Glutäal- und Analregion zugefügt. In dem ersten Status, der aus dem Krankenhaus stammt, wo der Patient zuerst behandelt wurde, wird festgestellt, dass der untere Teil des Rektums und die Analöffnung gänzlich von den umgebenden Geweben losgerissen sind. Das Diaphragma pelvis wird als intakt festgestellt. Es wurde ein Versuch gemacht, die Analöffnung an ihrer ursprünglichen Stelle zu fixieren.

Am 18. 8. 1941 war der Patient in ein anderes Krankenhaus verlegt worden. Hier wurde konstatiert, dass die früher ausgeführte Operation eine Infektion zur Folge gehabt hatte. Aus der Analöffnung stach ein Gummidrain hervor, das in das Rektum hineinführte. Von dem Drain bis ans Sakrum erstreckte sich ein faustgrosser Wundkrater mit grau-belegtem Boden und fäkulentem Geruch. Der Allgemeinzustand war sehr mitgenommen. Hgl. 16%.

Um bessere Heilungsverhältnisse herbeizuführen, wurde am 29. 8. 1941 ein Anus präternaturalis iliacus angelegt. Der Patient befand sich damals in einem sehr schlechten Zustand mit ausgedehntem Dekubitus. Der Zustand besserte sich aber nach der Operation rasch. Die Dekubitalwunden heilten, und die Wunde in der Analgegend reinigte und verkleinerte sich.

Am 8. 5. 1941 kam der Patient in der chirurgischen Abteilung der Diakonissenanstalt Helsingfors an. Er wurde zunächst vorwiegend konservativ mit Sitzbädern behandelt und es ging ihm rasch besser. Er hielt sich auch zeitweise mehrere Monate hintereinander zu Hause auf. Am 13. 7. 1942 wurde festgestellt, dass sämtliche Wunden geheilt waren, und dass der Anus präternaturalis vorzüglich funktionierte.

Da sich der Patient jedoch durch seinen Anus präternaturalis äusserst belästigt fühlte, der seines Erachtens bei jeder Tätigkeit störend wirkte, wurde am 7. 1. 1943 in Äthernarkose die *Sphinkterplastie* ausgeführt. Die ausgedehnte Narbe um die frühere Analöffnung wird exzidiert. Das Rektum wird herauspräpariert und so von der Umgebung abgelöst, dass man es mit Leichtigkeit an dem Wundrand hinabziehen kann. Auf beiden Seiten werden von M. glutaeus maximus Lappen von 3 cm Breite freigelegt und von ihren Respektiven Insertionen am Sakrum abgelöst. In diesen Lappen werden in Richtung der Muskelfasern 2 cm lange Löcher gesetzt, durch welche das Rektum gezogen wird. Die Lappen werden mit einigen Katgutnähten übereinander befestigt. Das Rektum wird mit Seide in die Haut eingenäht, die im übrigen exakt geschlossen wird.

Nach der Operation war die neue Analöffnung für einen Finger durchgängig. Der Patient wurde ermahnt, sich fleissig in der Kontraktion des *M. glutäus maximus* zu üben. Am 27. 2. 1943 wurde konstatiert, dass die Wunde per primam verheilt war. Die Analöffnung war damals für reichlich einen Finger durchgängig. Die Kontraktion in der Muskelplastik war gut. Am 16. 6. 1943 wurde der Anus präternaturalis iliacus des Patienten geschlossen. Heilung per primam. Danach kam der Stuhl durch die neue Analöffnung, ohne Beschwerden zu verursachen.

Nachuntersuchung 29. 10. 1943: Es wird eine sich vom Perineum bis zum Sakrum erstreckende, gut verheilte Narbe von 10×2 cm konstatiert. Die neue Analöffnung befindet sich ungefähr an der Stelle der ursprünglichen Analöffnung. Sie ist für reichlich einen Finger durchgängig. Bei Aufforderung zieht der Patient die Öffnung zusammen. Hierbei empfindet der touchierende Finger einen Zug von beiden Seiten und die Öffnung schliesst sich vollständig.

Der Patient gibt an, dass er das Herannahen des Stuhls fühlt und auch nachts davon geweckt wird. Durch kräftige Kontraktion der Glutäalmuskeln kann er denselben 5—10 Minuten zurückhalten und hat dann Zeit, einen Abtritt zu erreichen. Kann auch diarrhoischen Stuhl zurückhalten. Während der Arbeit passiert es jedoch, wenn auch selten, dass etwas flüssiger Stuhl unfreiwillig abgeht. Patient ist selbst sehr zufrieden mit seinem gegenwärtigen Zustand und meint, dass er ohne grössere Beschwerden zu seiner ursprünglichen Arbeit imstande ist.

Fall III. V. T. Arbeiter. 23 J. Hat sich am 9. 12. 1939 ein grosses Trauma in der Analgegend zugezogen, wobei der Analsphinkter völlig zerrissen wurde und die Ampulla recti extraperitoneal rupturierte.

Am 10. 12. 1939, als der Patient in Krankenhausbehandlung kam, wurde festgestellt, dass das Os ischii auf der linken Seite zertrümmert, der *M. sphincter* vollständig zerstört und die Ampulla recti nach aussen völlig offen war. Die Wunde war von Knochensplittern und Fäkalmassen erfüllt. Es wurde eine sorgfältige Wundrevision vorgenommen und die Ampulla recti geschlossen. In das Rektum wurde ein Drain eingelegt. Die Wunde infizierte sich jedoch und klaffte einige Tage später in ihrer ganzen Ausdehnung. Wurde danach konservativ mit Kompressen und Spülungen behandelt. Die Entzündungssymptome gingen unter dieser Behandlung langsam zurück und die Narbenbildung setzte ein.

Bei der Untersuchung am 13. 8. 1940 wurde festgestellt, dass der Anus völlig inkontinent war. Durch die Narbenbildung war er indessen so geschrumpft, dass er nur für einen Finger durchgängig war. Hierbei konnte man eine grosse Höhle palpieren, die von harten Fäkalmassen ausgefüllt war.

Am 9. 9. 1940 langte Patient in der chirurgischen Abteilung der Diakonissenanstalt Helsingfors an. Damals wurde konstatiert, dass die Narbenschumpfung um den Anus weiter in zugenommen hatte. Die Ampulla recti war nach wie vor voll von harten Fäkalmassen. Der Patient hatte heftige Strikturbeschwerden. Deshalb wurde am 27. 9. 1941 ein Anus präternaturalis iliacus angelegt. Die heftigen Beschwerden hielten jedoch an. Der Patient hatte oft Schmerzen und Erbrechen. Aus dem Anus präternaturalis prolabierte der zuführende Darmteil ungefähr 10 cm. Die ursprüngliche Analgegend war von einer ausgedehnten Narbe ausgefüllt, die ein für die Kleinfingerbeere durchgängiges Loch mit steifen Rändern enthielt. Letzteres führte in die Ampulla recti.

Wegen der Beschwerden des Patienten wurde am 9. 12. 1942 eine *Sphinkterplastie* in Äthernarkose ausgeführt. Die ausgedehnte Narbe zwischen Perineum und Sakrum wurde exzidiert. Das Rektum wurde freigelegt und vorsichtig von den umgebenden Narbenmassen abgelöst. Von beiden Glutaeus-maximus-Rändern wurden 3 cm breite Lappen abgetrennt, die von Sakrum abgelöst wurden und distal mit dem Muskel im Zusammenhang bleiben. Der rechtsseitige Lappen bestand vorwiegend aus Narbenmassen. In beiden Lappen wurde ein 2 cm langes Loch gesetzt. Das Rektum wurde alsdann zuerst durch den rechten, hierauf durch den linken Lappen gezogen. Dieselben wurden mit Katgutnähten übereinander fixiert. Das Rektum wurde mit Seide etwa an der ursprünglichen Analstelle in die Haut eingenäht. Die Wunde wurde mit Seide geschlossen, und in den unteren Wundwinkel wurde ein Drain eingelegt.

Am 29. 12. 1943 wurde festgestellt, dass die Wunde bis auf eine kleine Fistel am unteren Wundrand verheilt war. Am 21. 6. 1943 wurde die Seelusio ani präternaturalis angeschlossen. Am 6. 8. 1943 wurde konstatiert, dass sämtliche Wunden verheilt waren.

Nachuntersuchung am 15. 10. 1943: Es wird festgestellt: In der Crena ani eine 15 cm lange gut verheilte Narbe. Inmitten dieser Narbe befindet sich die neue Analöffnung, die für zwei Finger durchgängig ist. Bei der Kontraktion zieht sich der Anus zusammen und dies geschieht in erster Linie durch einen Zug von rechts nach links.

Der Patient gibt an, dass er fühlt, wenn der Stuhl herannaht. Dies Gefühl weckt ihn auch bei Nacht. Wenn der Stuhl wie gewöhnlich geformt ist, kann der Patient ihn durch die Glutäalkontraktion zurückhalten, bis er einen Abtritt erreicht. Wenn der Patient steht oder liegt, kann er auch Flatus und flüssigen Stuhl zurückhalten, aber wenn er sich in Bewegung befindet, gehen dieselben oft unfreiwillig ab. Er trägt aus diesem Grund einen einfachen Verband, der aus einer T-Binde und etwas Zellstoff besteht.

Der Patient ist mit seinem gegenwärtigen Zustand sehr zufrieden.

Seines Erachtens ist er völlig sozial geworden und hat seine Stellung in einer Möbelwerkstatt ohne Schwierigkeit ausfüllen können.

Diskussion.

Wenn man sich zu einer Beurteilung des Resultates in den drei oben referierten Fällen anschickt, ist man gezwungen, sich zunächst klar zu machen, wie es um die Kontinenz bestellt ist, die man mit einer plastischen Operation der hier beschriebenen Art erreichen kann.

Der *M. sphincter ani* ist ein quergestreifter Muskel, der dem Willen unterworfen ist. Die normale Kontinenz beruht darauf, dass dieser Muskel sich auch in der Ruhe in einer gewissen tonischen Kontraktion befindet. Beim Andrängen der Fäkalmassen kann die Kontraktion weiterhin verstärkt werden; bei der Defäkation wird alles dies unter dem Einfluss des Willens gelöst. Ein gewöhnlicher quergestreifter Muskel wie z. B. der *M. glutaeus maximus* kann nicht in einer solchen tonischen Kontraktion bleiben. Dies lässt sich nicht einmal durch ein sehr langwieriges Training erreichen. Während des Schlafes erschlaffen die gewöhnlichen quergestreiften Muskeln ebenfalls, und ihre eventuellen Aktionen sind dem bewussten Willen dann nicht unterworfen.

Mittels einer einfachen Verengerung der Analöffnung bringt man ebensowenig eine Kontinenz zustande. Wenn eine derartige Verengerung so gross ist, dass sie wirklich auch flüssigen Stuhl zurückhält, gibt sie sicher zu Stenosebeschwerden Veranlassung, ist sie wiederum geringer, so gehen die Fäces natürlich unabhängig vom Willen ab. Die Methoden DELORMES und GERSUNYS haben auch nicht zu einem endgültig befriedigenden Ergebnis geführt. Es ist somit eine aktive Kontraktion notwendig, und diese kann nur mittels einer Plastik erzielt werden, die mit Hilfe nahegelegener quergestreifter Muskeln gemacht wird. Und da liegt der *M. glutaeus maximus* am nächsten und ist auch sonst operationstechnisch am leichtesten zugänglich.

Bei sämtlichen hier nachuntersuchten Fällen hat sich die schon früher bekannte Tatsache bestätigt, dass die in der Ampulla recti — auch einer neugebildeten solchen — anlangenden Fäkalmassen deutliche Gefühlssensationen hervorrufen. Diese Gefühlssensation ist in sämtlichen Fällen so stark gewesen, dass sie den Betreffenden auch bei Nacht geweckt hat. Ausgehend von diesem Sachverhalt,

kommt man zu der Feststellung, dass auch mit einem gewöhnlichen quergestreiften Muskel eine gewisse Kontinenz zustandegebracht werden kann. Ist nämlich auf plastischem Wege eine kontraktive Analöffnung bei dem Patienten hergestellt worden, so warnen ihn die erwähnten Gefühlssensationen und er kann die andrängenden Fäkalmassen zurückhalten, bis er einen Abtritt erreicht. Durch fleissige Übung lässt sich die Zeit, während welcher die Kontraktion aufrechterhalten werden kann, erheblich verlängern.

Bei allen hier beschriebenen Fällen konnte bei der Nachuntersuchung eine relativ kräftige von den Lappen der Plastik bewirkte Kontraktion nachgewiesen werden. Ausgehend von dem, was oben über die Erzielung einer Kontinenz unter Verwendung von Lappen aus quergestreifter Muskulatur gesagt worden ist, muss man dass Resultat in den zwei ersten Fällen, in denen die Patienten sowohl festen als auch flüssigen Stuhl aktiv zurückhalten können, als gut betrachten, während der dritte Fall, wo der Patient nur in der Ruhe für festen und flüssigen Stuhl kontinent ist, welcher letzterer, wenn Pat. sich in Bewegung befindet, oft unfreiwillig abgeht, als befriedigend bezeichnet werden kann.

Wenn man dann zu einer näheren Betrachtung des Kontraktionsmechanismus schreitet, liegen für diesen zwei mögliche Wirkungsweisen vor. Einerseits kann man annehmen, dass die Muskellappen ihr aktives Kontraktionsvermögen beibehalten, andererseits, dass sie vernarben und nur als Bindegewebssehlingen wirken, die die Kontraktionskraft des resp. M. glutaeus maximus auf die Analöffnung übertragen.

Die Methoden SCHOEMAKERS und CHETWOODS, die der Handbuehliteratur zufolge die besten sind, zielen auf eine aktive Kontraktion der Lappen selbst ab. Die Lappen sind bei beiden Methoden so geschnitten, dass sie nicht mehr am Muskel sondern nur noch am Sakrum inserieren. Sie nehmen also nicht mehr an der eigentlichen Glutäalmuskelkontraktion teil und sind überdies von ihrer Innervation abgeschnitten. SCHMIEDEN ist deshalb der Ansicht, dass die erzielte Wirkung lediglich auf einer Narbenverengerung beruht.

Bei den vorliegenden Fällen hat sich eine deutliche und relativ starke aktive Kontraktion unzweideutig nachweisen lassen. Die stumpf abgelösten und distal am Muskel gestielten Lappen sind überdies so freigelegt, dass man annehmen kann, die Innervation seitens der Nn. glutaei inferiores sei beibehalten. Dass in dem dritten Fall, wo nur der eine Lappen funktionstauglich, der

andere dagegen schon zur Zeit der Operation bindegewebig umgebildet war, ein schlechteres Resultat erreicht wurde, deutet ebenfalls darauf hin, dass die Wirkung durch eine aktive Kontraktion in den Lappen zustandekommt. Bei der Nachuntersuchung wurde ja auch konstatiert, dass die Kontraktion in diesem dritten Fall einseitig ist.

Es kann jedoch nicht ganz ausgeschlossen werden, dass die Kontraktion durch bindegewebig umgebildete Schlingen zustandekommt, die die Glutäalkontraktion passiv auf die Analöffnung übertragen. Das Wirkungsprinzip würde dann mit demjenigen übereinstimmen, das bei den Methoden WREDES und STONES zur Anwendung kommt. Hierbei wird, wie früher erwähnt, die Kraft des Glutäalmuskels mittels transplanterter Faszien-schlingen übertragen.

Eine endgültige Entscheidung dieser Frage ist noch nicht erreicht worden. Vielleicht würde ein histologisches Präparat eines Lappens in einem späteren Stadium ausschlaggebend sein können. Es kann aber nicht angebracht erscheinen, diese schon wiederholt operierten Patienten noch einer Operation zu unterziehen, da das Ergebnis nur von rein theoretischem Interesse wäre.

Was alsdann die Operationsmethode selbst betrifft, so darf man wohl sagen, dass sie technisch relativ einfach ist. Eine Plastik mit Lappen von dem oberflächlich gelegenen *M. glutaeus maximus*, von dem man ausserdem in Anbetracht seiner Dimensionen relativ grosse Lappen ohne grössere Funktionsverluste abtrennen kann, ist unbedingt vorteilhafter als eine solche mit Lappen von dem tief gelegenen *M. levator ani*. Aus den Nachuntersuchungen geht überdies hervor, dass man stets ein gewisses relativ gutes Resultat zu erwarten hat. Die Fälle müssen jedoch natürlich so günstig wie möglich ausgewählt werden. Wo ein restituierbarer *M. sphincter ani externus* vorhanden ist, ist selbstverständlich eine Plastik unter Verwendung von Resten desselben vorzuziehen. Ist aber der *M. sphincter ani* völlig zerstört oder entfernt, so ist die in dieser Arbeit beschriebene Methode geeignet. Eine beachtenswerte Bedingung ist ferner, dass sich der *M. glutaeus maximus* auf beiden Seiten in solchem Zustand befindet, dass wirklich funktionstaugliche Lappen davon abgetrennt werden können. Selbst wenn eine Infektion hinzutreten sollte, scheint man bei dieser Methode mit einem besseren Ergebnis rechnen zu können, als bei denjenigen, wo die Lappen mit Nähten fixiert werden.

Der spätere Verlauf der beschriebenen Fälle hat schliesslich

erwiesen, dass durch die Operation keine grösseren Gefahrmomente für den Patienten entstehen. Die Analöffnung ist nach der Operation gut durchgängig gewesen, und es sind keinerlei Stenosebeschwerden verspürt worden. Eine postoperative Infektion ist in keinem der Fälle in grösserer Ausdehnung vorgekommen. Praktisch betrachtet, kann man sagen, dass der Verlauf nach der Operation komplikationsfrei gewesen ist. Die Infektionsgefahr ist bei einer Methode, wo Faszientransplantate verwendet werden, sicher grösser.

Schliesslich kann man sich noch an die eigenen Aussagen sämtlicher operierten Patienten halten. Alle haben bei der Nachuntersuchung angegeben, dass sie mit ihrer neuen kontrahierbaren Analöffnung besser zurechtkommen als mit dem Anus præternaturalis iliacus, der bei allen in einem früheren Stadium angelegt worden war. Sämtliche Patienten sind auch als völlig soziale Gesellschaftsmitglieder zu einer regelmässigen Arbeit zurückgekehrt und geben an, dass sie dieselbe ohne grössere Beschwerden verrichten können.

Als Zusammenfassung des oben Ausgeführten kann man somit sagen,

1. dass die beschriebene Methode, wenn sie in Fällen angewandt wird, wo der *M. sphincter ani ext.* gänzlich zerstört oder entfernt ist, mit Sicherheit zu einem Ergebnis führt, das als so gut betrachtet werden muss, wie man es unter Verwendung gewöhnlicher Skelettmuskulatur bei der Analplastik überhaupt erwarten kann.

2. dass die Methode technisch relativ einfach ist und keine grösseren Gefahrmomente für den Patienten mitsichbringt.

3. dass sämtliche Patienten selbst sehr zufrieden mit dem Ergebnis waren, und dass sie nach der Operation als soziale Mitglieder der menschlichen Gesellschaft zu einer regelmässigen Arbeit übergehen konnten.

4. dass die Methode es in passend ausgewählten Fällen verdient, trotz der Enttäuschungen, die frühere ähnliche Methoden mitsichgebracht haben, zur Anwendung zu kommen.

Zusammenfassung.

Nach einer kurzen Übersicht über die früher angewandten Methoden der Analplastik wird über eine Methode berichtet, bei der Lappen vom *M. glutaeus maximus* verwendet werden. Hierbei

werden, auf beiden Seiten 3—5 cm breite Lappen herauspräpariert, die distal am Muskel gestielt bleiben. In beiden Lappen wird eine 2 cm langes Loch gesetzt. Hierauf werden sie übereinandergengenäht und wird der freigelegte Mastdarmstumpf durch die Löcher gezogen sowie an der ursprünglichen Stelle in die Haut eingenäht.

Es werden drei Fälle beschrieben, bei denen die Operation ausgeführt wurde. Bei einem Fall war das Rektum amputiert und bei den zwei anderen Fällen war der Analsphinkter durch ein Trauma völlig zerstört worden. Zwei von den Fällen können nach ausgeführter Operation sowohl flüssigen als auch festen Stuhl zurückhalten. Bei dem dritten Fall geht flüssiger Stuhl bisweilen unfreiwillig ab, wenn sich der Patient in Bewegung befindet. In Anbetracht dessen, was man von einer Analplastik unter Verwendung von Lappen aus gewöhnlicher Skelettmuskulatur erwarten kann, werden die Ergebnisse in den beiden ersten Fällen als gut, in dem dritten als befriedigend bezeichnet.

Summary.

Following a brief review of methods of plastic repair of the anus applied hitherto, the author describes a method in which flaps from the gluteus maximus are used. Three- to five-centimeter wide flaps are prepared with distal attachment to the muscle. A two-centimeter long hole is made in the direction of the fibers in both flaps. Then the flaps are sutured over each other and the stump of the rectum, which has been dissected free, is drawn through the holes and sutured to the skin at the original site.

Three cases of this operation are described. In one case the rectum was amputated and in the other two the anal sphincter had been completely destroyed by a trauma. After the operation two of the patients were able to retain both liquid and firm fecal matter. The third patient sometimes passed liquid stools involuntarily, mostly when he was in motion. In view of what can be expected from plastic repair of the anus with flaps from ordinary skeletal muscles, the results may be considered good in the first two cases and satisfactory in the third.

Résumé.

Après une courte revue des anciennes méthodes de plastique anale l'auteur décrit un procédé où l'on utilise des lambeaux du grand fessier. On dissèque des deux côtés des lambeaux de trois à cinq centimètres de largeur qui restent attachés au muscle par un pédicule distal. Dans chacun des lambeaux on fait une boutonnière longue de 2 cm., dans la direction de leurs fibres. Puis on les coud l'un sur l'autre, et le bout du rectum qu'on a libéré par dissection est attiré à travers les boutonnières et suturé à la peau à son ancienne place.

Description de trois cas opérés de la sorte. Dans l'un le rectum avait été amputé, et dans les deux autres le sphincter anal avait été complètement détruit par un traumatisme. Deux des malades peuvent depuis l'opération retenir les matières solides et liquides. Le troisième laisse parfois échapper involontairement des matières liquides lorsqu'il est en mouvement. Compte tenu de ce qu'on peut attendre d'une plastique anale par lambeaux prélevés sur la musculature ordinaire du squelette, l'auteur déclare bon le résultat obtenu dans les deux premiers cas, et satisfaisant celui dans le troisième.

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Aus der chirurgischen Abteilung des St.-Göran-Krankenhauses,
Stockholm.
(Vorstand: Prof. A. TROELL.)

Intrathorakale Struma.

Von

J. O. von ZWEIGBERGK.

Intrathorakale Struma ist ein Begriff, der von den einzelnen Autoren mit wesentlich verschiedener Bedeutung angewendet wird. Bei etlichen ist dies die Bezeichnung für sämtliche Strumen, welche überhaupt unter das Jugulum hinabreichen, während andere mit dem Ausdruck nur solche Kröpfe meinen, deren Umfang innerhalb der Brusthöhle verhältnismässig gross geworden ist. Hierin kann auch die Erklärung für die abweichenden Angaben verschiedener Autoren über die Anzahl intrathorakal entwickelter Strumen in verschiedenen Fallsammlungen liegen. So gibt LAHEY an, dass in einem Material von insgesamt 15300 operierten Strumen 1300 intrathorakal waren, d. s. ungefähr 11 v. H., SHARER hat 0,3 v. H., die *Mayo Clinic* 0,6 v. H. und HIGGINS 1—2 v. H. Leider haben nicht alle Autoren definiert, was sie unter einer intrathorakalen Struma verstehen, aber der Kasuistik nach dürfte es die vorstehend besprochene Verschiedenheit der Beurteilung sein, welche bewirkt, dass die Prozentzahlen so beträchtlich schwanken.

Der Zusammenstellung, über welche im folgenden berichtet werden wird, liegt Professor ABRAHAM TROELLS Strumamaterial aus den Jahren 1919 bis einschliesslich 1940 zugrunde. Insgesamt besteht das Material aus über 2625 operierten Strumafällen. Von diesen waren 21, also ungefähr 0,8 v. H., intrathorakal. Als solche sind da nur ganz oder teilweise im Brustraum liegende Strumen gerechnet, welche an den Aortenbogen oder unter diesen hinabgereicht haben. Sonstige kleinere, substernale Strumen wurden hierbei nicht berücksichtigt.

Dass sich eine Struma überhaupt intrathorakal entwickeln und dabei mitunter einen so grossen Umfang erreichen kann, wird

einerseits durch die konische Form der Brusthöhle und den Sitz des Kropfes in der oberen Thoraxapertur erklärt, andererseits durch den Charakter der vorhandenen Struma. Die intrathorakalen Strumen sind in der Regel ausschliesslich vom nodösen Typus, und ihr Wachstum geht folgendermassen vonstatten: Es bildet sich ein Adenom im unteren Pol eines der Seitenlappen, also gerade in der Thoraxapertur. Wenn dieses Adenom dann zu wachsen beginnt, geschieht dies leicht nach dem Gesetz des geringsten Widerstandes in Richtung nach unten, in die Brusthöhle hinein. Das Wachstum erfolgt sehr langsam; dies steht auch im Einklang mit der langen Anamnese, der man bei dieser Form des Kropfes meistens begegnet. Von den hier vorliegenden 21 Fällen hatten nur 4 (Fall 3, 4, 5 und 18) eine Krankheitsdauer unter 10 Jahren, und die kürzeste Vorgeschichte erstreckte sich über 3 Jahre (Fall 5). Die meisten hatten ihre Struma seit der Kindheit gehabt.

Meist waren beide Schilddrüsenlappen vergrössert. So waren 14 Strumen doppelseitig, 4 links- und 3 rechtsseitig. Dagegen war die intrathorakal entwickelte Partie nur bei 2 Fällen doppelseitig; bei 12 Fällen war sie linksseitig und bei 7 rechtsseitig. Bei 3 von den 21 Fällen bestand kein sichtbarer Kropf am Halse. Von den operierten Kranken waren alle bis auf 4 Frauen. Das Alter bei der Operation wechselt zwischen 33 und 72 Jahren. In den allermeisten Fällen liegt es zwischen dem 40. und 50. Lebensjahr.

Nach den meisten Arbeiten über intrathorakale Strumen liegen diese gewöhnlich im vorderen Mediastinalraum, d. h. vor der Trachea. Hierauf hat namentlich v. HABERER aufmerksam gemacht, und im deutschen Schrifttum findet man oft einzelne Fälle von intrathorakaler Struma im hinteren Mediastinum als Seltenheiten beschrieben. Es ist daher der Hinweis am Platze, dass bei einer grossen Anzahl der hier erörterten Fälle der intrathorakale Teil im hinteren Mediastinum lokalisiert war, entweder zwischen Trachea und Oesophagus, oder auch hinter beiden. Bei nicht weniger als 7 Fällen lag die intrathorakale Struma hinter der Trachea.

Symptomatologie.

Die auffälligsten Symptome waren Druckerscheinungen seitens der Trachea, welche sich als Kurzatmigkeit bei der geringsten Anstrengung und Reizhusten äusserten. Wirkliche Erstickungs-

anfälle kamen nur ganz vereinzelt vor, und ebenso waren Schlingbeschwerden nicht häufig. Dagegen klagten die Kranken oft über ein Gefühl von »Druck am Halse«. Auch Heiserkeit trat auf, auch wenn keine laryngoskopisch nachweisbaren Veränderungen vorhanden waren. Wo sich derartige Veränderungen entdecken liessen, handelte es sich meistens um eine Abductorparese des einen Stimmbandes, welches in Mittelstellung stillstand (diese Veränderungen verschwanden in den meisten Fällen nach der Operation). Toxische Symptome bestanden bei 11 Fällen, die Grundumsatzwerte wechselten hierbei zwischen niedrigstens + 23 und höchstens + 72. Im allgemeinen hielten sich die Grundumsatzwerte zwischen + 30 und + 50. Auffallend sind die verhältnismässig geringen Beschwerden bei einer ganzen Anzahl der Kranken, trotz grosser intrathorakaler Strumen. Oftmals war die sichtbare Schilddrüsenvergrösserung der einzige Anlass dafür, dass der Arzt aufgesucht wurde. Örtlich liess sich im allgemeinen eine vergrösserte Thyreoidea palpieren, aber bei 3 Fällen war diese Vergrösserung so unerheblich, dass sie der Inspektion entging. In den meisten Fällen konnte man fühlen, dass der Kropf auf der betreffenden Seite in der Brusthöhle verschwand und sich demgemäss nicht in der Fossa jugularis abgrenzen liess. Manubriumdämpfung war bei einem Teil der Fälle zu konstatieren, aber nicht bei allen. Gefässgeräusche kamen niemals vor. Gesichtsödem infolge von Druck auf die Venen wurde in gewissen Fällen beobachtet, bei einem Fall auch eine Erweiterung der oberflächlichen Halsvenen.

Das Herz wies bei den meisten Fällen keine Veränderungen auf, und auch der Blutdruck war im grossen ganzen normal, abgesehen von einer gewissen Erhöhung bei den älteren Kranken.

Die Röntgenuntersuchung lieferte bei sämtlichen Fällen ein positives Ergebnis. Teils liess sich der Weichteilschatten bis ins Mediastinum verfolgen, teils konnte die Dislokation und Kompression der Trachea nachgewiesen werden. Die Kompression war mitunter ziemlich hochgradig, entweder von Seite zu Seite oder von vorn nach hinten. In bezug auf diese Tracheaveränderungen kann Erwähnung verdienen, dass die Kompression, wie sich bei Nachuntersuchung der Kranken herausstellte, fast stets verschwunden war, während die Dislokation bei einigen Fällen weiterbestand.

Tabelle

Fall	Geschlecht, Alter, Jr.-Nr.	Diagnose	Dauer, subj. Beschwerden	Klinische Symptome
1	♀, 33 J. 799/26	S. n. t.	> 17 J., Druck, Heiserkeit	Manubr.-Dämpfg. Grundums. + 72
2	♀, 35 J. 2050/27	S. n. t.	20 J., Kurzatmigkeit, Herzklopfen	mäss. äussere Vergrösserung. Grundums. + 35
3	♀, 49 J. 802/30	S. n. t.	6 J., Herzklopfen, Druck	mäss. äussere Vergrösserung. Grundums. + 32
4	♀, 44 J. 458/31	S. n. t.	5 J., Nervosität, Herzklopfen	linksseit. Vergrösserung. Grundums. + 23
5	♀, 36 J. 2087/33	S. n. at.	3 J., Kurzatmigkeit	rechtsseit. Vergrösserung. Grundums. + 3
6	♀, 76 J. 2439/34	S. n. at.	55 J., Atembeschw., Heiserkeit	Stridor. Doppelseit. Vergrösserung. Manubr.-Dämpfg. Grundums. + 6
7	♀, 70 J. 385/35	S. n. t.	50 J., Kurzatmigkeit, Herzklopfen	rechtsseit. Vergrösserung. Tremor. Grundums. + 16
8	♀, 57 J. 2599/34	S. n. at.	20 J., Kurzatmigkeit, Herzklopfen, Nervosität	geringe palpable Vergrösserung. Grundums. — 1
9	♀, 64 J. 66/36	S. n. at. rezidiv.	40 J., damals in USA. operiert. Kurzatmigkeit	sehr grosse Manubr.-Dämpfg.
10	♀, 38 J. 196/36	S. n. at. rezidiv.	20 J., 2mal operiert (vor 12 bzw. 10 Jahren). Keine Atembeschwerden	mäss. Vergrösserung. Grundums. + 9

S. n. t. = Struma nodosa toxica, S. n. at. = Struma nodosa atoxica.
Der Röntgenbefund bezieht sich auf Kompression oder Dislokation der Trachea.

¹ Erneute Resect. lob. sin. 1939. Gew. 50 g.

1.

Röntgenbefund	Operation, Gewicht d. Op.- Präparats	Ergebnisse v. Nachun- tersuchungen
Kompression seitlich u. von vorn	Resect. lob. amb. Tamponade m. Mikulitzschem Beutel. Gew. 250 g	Keine Beschwerden. Röntgenbef.: keine Kompression
Kompression von vorn	Resektionsenukleation. Ein Drain- rohr. Gew. 50 g	Keine Beschwerden. Röntgenbef.: o. B.
fehlt	Resect. lob. sin. Drainage. Gew. 55 g	Keine Beschwerden. Röntgenbef.: o. B.
Kompression von rechts u. hinten	Resect. lob. amb. Zwei kleine Drainrohre. Gew. 100 g	Keine Beschwerden. Röntgenbef.: keine Kompression, etw. Dislokation
Dislokation u. Kom- pression v. rechts u. von vorn n. hinten	Enukleationsresektion. Drainrohr. Gew. 180 g	—
Kompression von hinten u. seitlich	Resect. lob. amb. Stryphnontam- ponade + Drainrohr. Gew. 210 g	Etwas heiser. Recht. Stimmband weniger beweglich. Röntgen- bef.: Dislokation, keine Kompression
Verschiebung nach links	Resect. lob. dextr. Drainrohr. Gew. 75 g	Lt. Brief Wohlbefinden
Kompression von hinten u. beid. Seiten	Resect. lob. amb. mit teilweiser Zerstückelung. Temporäre Tam- ponade. Drainrohr + Stryph- nongaze. Gew. 130 g	Linksscit. Rezidiv. ¹ Röntgenbef.: Dislo- kation nach rechts
Struma reicht bis zum Hilus. Dislo- kation nach rechts Kompression von hinten	Resect. lob. amb. Höhle m. Koch- salz gefüllt. Zwei Drainrohre. Gew. 600 g	Keine subj. od. obj. Erscheinungen. Röntgenbef. o. B.
Kompression von hinten u. Disloka- tion nach links	Resect. lob. amb. Temporäre Tam- ponade. Zwei Drainrohre + ein Rohr in d. Brusthöhe. Gew. 184 g	Lt. Brief Wohlbefinden

Röntgenbefund	Operation, Gewicht d. Op.- Präparats	Ergebnisse v. Nachun- tersuchungen
Kompression von beid. Seiten u. von vorn	Resect. lob. amb. + linksseit. in- trathorakal. Partie hinter d. Trachea. Zwei Drainrohre. Gew. 945 g	Lt. Brief Wohlbefinden
Dislokation nach rechts	Resektionsenukleation d. linksseit. Partie hinter d. Trachea. Zwei Drainrohre. Gew. 43 g	Keine Symptome. Röntgenbef.: o. B.
Dislokation nach rechts, Kompres- sion von hinten	Enukleationsresektion. Heraus- luxieren m. Haltenaht u. Ko- cherschem Spatel. Ein Drain- rohr in d. Brusthöhle. Gew. 72 g	—
Dislokation nach links, Kompres- sion von vorn nach hinten u. von beid. Seiten	Resect. lob. amb. Zwei Drainrohre. Gew. 215 g	Keine subj. od. obj. Erscheinungen. Grundums. — 9. Röntgenbef.: keine Dislokation, leichte Kompression
Dislokation nach rechts, Kompres- sion von hinten	Resect. lob. amb. Herausluxieren einer grossen linksseit. Partie. Zwei Drainrohre. Gew. 145 g	Lt. Brief keine Er- scheinungen
Dislokation nach rechts, Kompres- sion von Seite zu Seite	Resect. lob. sin. Herausluxieren einer grossen linksseit. Partie m. Kocherschem Spatel. Zwei Drainrohre. Gew. 140 g	Keine subj. od. obj. Erscheinungen. Kein Röntgenbild
Dislokation nach rechts, Kompres- sion von vorn	Resect. lob. amb. Herausluxieren einer grossen linksseit. Partie. Zwei Drainrohre. Gew. 250 g	Keine subj. od. obj. Erscheinungen
Dislokation nach rechts Kompres- sion von vorn	Resect. lob. amb. Herausluxieren einer grossen linksseit. Partie m. Fingern u. Péans. Zwei Drainrohre. Gew. 336 g	† zwei Tage nach d. Operation an Bron- chopneumonie
Dislokation nach links, Kompres- sion von vorn	Resect. lob. amb. Herausluxieren einer gänseeigrossen rechtsseit. Partie m. Kocherschem Spatel. Zwei Drainrohre. Gew. 198 g	—
Dislokation nach links, Kompres- sion von vorn	Resect. lob. amb. Herausluxieren einer linksseit. Partie m. Péans. Zwei Drainrohre. Gew. 297 g.	Keine subj. od. obj. Beschwerden. Kein Röntgenbild.
Dislokation nach links, Kompres- sion von hinten	Resect. lob. amb. Stückweise Ent- fernung einer rechtsseit. Partie. Temporäre Tamponade. Ein Drainrohr. Gew. 376 g	—

Therapie.

Die Behandlung war bei allen Fällen operativ. Die absolute Operationsanzeige ist gegeben, sobald eine intrathorakale Struma diagnostiziert ist. Der Eingriff bestand in Resektion, entweder in subtotaler Resektion eines oder beider Lappen mit dem intrathorakalen Adenom, oder lediglich in Enukleationsresektion des Adenoms. Die Vorbehandlung war Bettruhe und bei den toxischen Fällen Kinifosgaben, bis die Pulskurve gesunken und eine sichere Gewichtszunahme eingetreten war. Das Gewicht wurde dabei jeden dritten Tag kontrolliert. Die Grundumsatzwerte wurden in den meisten Fällen niedriger, aber Puls und Gewicht wurde grössere Bedeutung beigemessen. Keiner der Fälle hat vor der Operation Jod erhalten. Den nicht toxischen Fällen wurden bei der Entlassung täglich 3 Tropfen einer 0,01prozentigen NaJ-Lösung verordnet.

Zur Schmerzlosmachung diente bei sämtlichen Fällen die Lokalanästhesie mit 1prozentigem Novocain mit Adrenalinzusatz. Dabei wurden, sofern es sich nicht um eine besonders grosse Struma handelte, 60 ccm vor dem Hautschnitt über das Operationsfeld verteilt; nach Freilegung der Muskulatur wurden weitere 40 ccm injiziert, und zwar hauptsächlich nach oben und in den M. sternocleidomastoideus sowie lateralwärts und abwärts in das Gewebe am Jugulum.

Das Operationsverfahren war folgendes: Kragenschnitt unmittelbar über dem Jugulum. Spaltung der geraden Muskelchen. Unterbindung und Durchtrennung der Vasa thy. sup. und Freipräparieren des oberen Pols des betreffenden Lappens. Die Art. thy. inf. wurde nur bei zwei Fällen unterbunden (im Beginn der Serie). Dann vorsichtige Freilegung der intrathorakalen Partie mit dem Finger, unter Umständen bei gleichzeitigem Zug mit Haltenaht. Darauf wurde die Struma mit dem Finger oder mittels des Kochersehen Spatels aus der Brusthöhle herausluxiert. Wenn dies sehr grosse Schwierigkeiten machte, wurden zunächst etwa vorhandene Zysten punktiert und der Inhalt abgesaugt, ab und zu nach Zerstückelung. Die Kapsel ist meistens ziemlich hart und fest. Macht man daher oben einen Einschnitt in dieselbe, und zerquetscht man dann den Inhalt mit dem Finger, so lässt sich die Strumapartie sehr leicht in der intakten Kapsel vorziehen. Hin und wieder einmal platzte die Kapsel, und die Struma musste

stückweise herausbefördert werden. Einmal war die Kapsel in der Tiefe so fest verwachsen, dass der unterste Teil derselben zurückgelassen werden musste. Nach dem Herausluxieren Abschnürung mit 2 starken Nahtfäden und Resektion mit Zurücklassen einer hinteren lateralen Partie. Die Thoraxhöhle wurde während der weiteren Resektion der Struma temporär tamponiert. Nachher wurde die Tamponade entfernt und die Gefässe sorgfältig unterbunden oder umstochen. Nur ausnahmsweise musste die Tamponade im Thorax liegengelassen werden, und sie wurde da an einem der auf die Operation folgenden Tage entfernt. Muskeln und Haut wurden genäht, nachdem zuvor auf jeder Seite ein kurzes Glas- oder Gummidrain eingelegt worden war, welches am 2. oder 3. Tage nach der Operation herausgenommen wurde. Ab und zu wurde ein Gummischlauch in Richtung auf die Brusthöhle eingeführt und dann ebenfalls nach 2 Tagen entfernt. Trachealkatheter wurden bei allen Operationen bereit gehalten, brauchten aber niemals angewendet zu werden. Die u. a. von SAUERBRUCH empfohlene Spaltung des Brustbeins hat sich als entbehrlich erwiesen, desgleichen die von LAHEY angeratene feste und langdauernde Tamponade der Thoraxhöhle. Das Gewicht der resezierten Gewebstücke schwankte zwischen niedrigstens 43 und höchstens 945 g. Im allgemeinen lag es zwischen 100 und 200 g.

Der postoperative Verlauf war in den meisten Fällen glatt, ohne Komplikationen.

Ein Fall kam 2 Tage nach der Operation plötzlich ad exitum. Die Obduktion ergab keine Besonderheiten im Operationsgebiet, aber eine Tracheo-Bronchitis purulenta + Bronchopneumonia bilateralis (Fall 18). Bei einem Fall trat nach der Operation eine exsudative Pleuritis auf der rechten Seite auf, und die Entlassung konnte infolgedessen erst 1 Monat nach der Operation erfolgen (Fall 21). Von den übrigen Kranken sind die allermeisten 1 Woche nach der Operation geheilt entlassen worden.

Eine einseitige Recurrensparese mit leichter Heiserkeit blieb bei einem Fall nach der Operation dauernd bestehen. Hierbei lag eine Abductorlähmung mit dem Stimmband in Mittelstellung vor.

Bei sämtlichen Fällen handelte es sich um nodöse Strumen mit einem oder mehreren makro- bzw. mikrofollikulären kolloidhaltigen Adenomen.

Nachuntersucht wurden 17 der Fälle, davon 4 1 Jahr nach der Operation, die übrigen mehrere Jahre nach derselben. Bei einem Fall kam ein Rezidiv vor, mit einer kleineren intrathorakalen Par-

tie auf der anderen Seite (Gewicht bei der 2. Operation 50 g). Die zweite Operation wurde 5 Jahre nach der ersten vorgenommen (Fall 8). Von den übrigen nachuntersuchten Kranken waren alle frei von sowohl subjektiven wie objektiven Beschwerden, bis auf die obenerwähnte Recurrensparese. Die Röntgenuntersuchung ergab, wie oben angegeben ist, hin und wieder einmal, dass eine gewisse Dislokation der Trachea weiterbestand; die Kompression war jedoch verschwunden.

Zusammenfassung.

Verf. berichtet über eine Zusammenstellung von intrathorakalen Strumen (Prof. TROELLS Material von operierten Strumen aus den Jahren 1919—1940). Das Gesamtmaterial besteht aus 2625 operierten Fällen, und von diesen waren 21 intrathorakal in dem Sinne, dass die Struma bis an den Aortenbogen oder unter diesen hinabreichte. Alle diese 21 Fälle wurden operiert. Die Operation bestand im allgemeinen in einseitiger oder doppelseitiger subtotaler Resektion der Lappen mit der intrathorakalen Partie, oder auch nur in Enukleationsresektion des Adenoms, ab und zu mit Zerstückelung. Der postoperative Verlauf war im allgemeinen komplikationslos. Bei einem Fall blieb eine dauernde Recurrensparese zurück. Ein Fall kam an Bronchopneumonia bilateralis ad exitum. 17 Fälle sind nach wenigstens einem Jahre nachuntersucht, und zwar — bis auf den Fall mit Recurrensparese und einen zweiten mit Rezidivoperation 5 Jahre später — mit durchaus gutem Endergebnis.

Summary.

The author has assembled the cases of intrathoracic struma in Professor TROELL's material of operated goiter from 1919 through 1940. The entire material consists of 2625 operated cases, 21 of which were intrathoracic in the sense that the goiters reached or passed the arch of the aorta. As a rule the operation consisted of unilateral or bilateral subtotal resection of the lobes with the intrathoracic portion or else of enucleation resection of the adenoma, sometimes with morcellation. Convalescence was generally uneventful. One patient contracted permanent recurrent paresis and one died of bilateral bronchopneumonia. Seventeen cases were submitted to after-examination one year after the operation,

and all of them — with the exceptions of the cases of recurrent paresis and another operated on for a recurrence after five years — showed good endresults.

Résumé.

L'auteur apporte une étude des cas de goîtres intrathoraciques provenant du matériel de goîtres opérés par le Prof. TROELL de 1919 à 1940 inclusivement. L'ensemble de ce matériel comprend 2625 cas opératoires, sur lesquels 21 étaient intrathoraciques, en ce sens que le goitre atteignait, ou dépassait par en bas, la crosse de l'aorte. Tous ces 21 cas ont été opérés. L'intervention a généralement consisté en résection lobaire uni- ou bilatérale, subtotale, comprenant la portion intrathoracique, ou bien il s'est agi d'une énucléation — résection de l'adénome, une fois ou l'autre avec morcellement. Les suites opératoires ont été habituellement dépourvues de complications. Il y a eu un cas de paralysie persistante du récurrent et un de mort par bronchopneumonie bilatérale. 17 cas ont été réexaminés après une année au moins, et tous — sauf celui de la paralysie récurrentielle, et un autre qui fut soumis à une opération pour récurrence 5 ans après — ont présenté un bon résultat final.

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From the Mariestad Hospital, Sweden.
(Surgeon in-chief: G. BAUER, M. D.)

Late Results of Denervation of the Kidney for Renal Pain.

By

GUNNAR BAUER.

In a paper read at a meeting of the Northern Association of Surgeons in Oslo, 1939, I had the opportunity of submitting an account of my experiences, up to that point, of the treatment of hydronephrosis and renal pain by denervation of the kidney. A detailed account, including case histories, appeared in *Acta Chir. Scand.* the same year.

By that time eleven cases had been treated. The immediate result of the operation was good in all cases. At that point, however, a definite opinion of the value of the treatment could not be formed owing to the shortness of the period the patients had been under observation, only four of them having been followed for more than one year, the rest a considerably shorter time.

Several years have passed since then, and the observational period now exceeds five years for every case. A follow-up examination has therefore been considered appropriate, and the results of this are reported below.

Seven new cases have presented themselves in the meantime and a brief account will also be given of these.

Follow-up Investigation.

It has been possible to arrange for a personal re-examination at the Mariestad Hospital of all the 5-year-old cases. The subjective symptoms of the patients have been studied in as objective a manner as possible, and the general condition, the state of the

cicatrix after the operation and the urinary sediment have been recorded. The results are given in the appended table.

Result of Renal Sympathectomy at the Mariestad Hospital.

Number of cases	Followed up for	Result	
		Good	Dubious
11	over 5 years	11	—
2	„ 4 „	1	1
2	„ 3 „	2	—
1	„ 1 year	1	—
2	under 1 „	2	—
18		17	1

It will be seen from the table that the result is good in all the cases which were followed up after more than five years.

Thus, in the first place, all the patients had become *free from pain*. The symptom originally constituting the reason for the operation had been pain dating back from several years to a few months, localized to one kidney only and, as a rule, consisting of intermittent colicky attacks, sometimes very severe, and with a marked tendency to occur at shorter and shorter intervals, or, in some cases, a more constant, prolonged, dull pain with liability to acute, severe exacerbations. All these symptoms disappeared immediately after the operation and have not since recurred.

A single patient stated that on a few solitary occasions, at intervals of many months, she could feel for a short while what she described as a "sensation of fulness" in that side of the abdomen which had been operated upon, though not at the same spot as before the operation. However, she was not in the habit of giving any heed to this and had never found it necessary to stop work or to use pain-relieving medicines.

All these patients exhibited a *good general condition*, mostly better than that before the operation. *No postoperative hernia* occurred.

The state of the denervated kidney was examined in all cases at least once after the operation, usually several times. The urine was invariably free from any pathologic constituents, and on the side operated on it was possible to distend the renal pelvis with fluid up to an amount of 20 cc. without causing the least

sensation of pain, whereas before the denervation quantities of 3—4 cc. up to 9—14 cc. elicited powerful attacks of pain.

It would therefore seem justifiable to assert that *the renal denervation has given an extremely good result in all these cases.* As a regeneration of the sympathetic tracts to the kidney, if such is at all possible, must have taken place long before, there is every reason to assume that the good result will also be *permanent.*

Seven further cases of renal sympathetico-tonus have been treated since the former report was published. The histories and examination findings in these new cases agree in all essentials with those of the previous cases, and therefore a detailed description is unnecessary. The operative technique has also been the same.

These seven cases have also been carefully followed up, although the time during which some of them have been under observation is too short, as is evident from the table. With this reservation it may be stated, however, that in this group, too, the result is good almost without exception. In one case, operated on four years ago, I have nevertheless preferred to denote the result as dubious. A short account of this case follows.

No. 176/40. G. L., female, aged 20. Once or twice a week for the past several years the patient has had attacks of pain in the right side of her abdomen, unaccompanied by nausea, vomitings, or the like. In the course of years these pains have occurred more and more frequently, and of late they have been coming on 3—4 or even more times a day. They are characterized by a feeling of strong tension or cramp in the right part of the abdomen, localized to the region of the kidney and radiating towards the back and a little downwards. These pains were not so severe at first that the patient could not continue her work. Recently, however, they had increased in frequency and had simultaneously become more and more intense. When the pains come on, she must stop her work at once and lie down on a sofa. After a while the pains then usually pass off and she experiences a sense of well-being and can resume work. On some occasions strangury has also appeared in association with the pains.

These troubles have induced the patient to seek medical advice on repeated occasions during these years. She has then been told that she is suffering from chronic appendicitis or similar affections, but no measures taken have afforded her any relief. On account of her ever-increasing distress she has now applied here and been admitted.

General sympathetico-tonus: Rather pronounced.

Urine: Nothing pathologic in sediment.

Urography: Right-sided hydronephrosis of only moderate degree. Slight clubbing of calyces. The ureter shows nothing abnormal, but on the film taken after release of pressure it is strongly contracted in contrast to the left ureter. Distinctly delayed emptying of the opaque medium.

Cystoscopy: Bladder and ureters normal. Catheterization easy. Ureteral drip: normal and the same on both sides. Ureteral sediment: nothing pathologic.

Pain reproduction test: Sudden and intense pain in right renal region after an injection of only $3\frac{1}{2}$ —4 cc. of physiologic salt solution through the ureteral catheter. The patient lies twisting herself about and showing every sign of being in great pain. Questions put in different ways very plainly elicit the fact that these pains are quite identical with those she has in her attacks. The pains immediately disappear when the piston of the syringe is drawn back.

Retrograde pyelography: In prone position slight hydronephrosis and clubbing of calyces. In upright position no descent of the kidney. No kinking of the ureter observed. The otherwise eustomary re-photographing after ten minutes to ascertain whether there is retention in the kidney could not be undertaken owing to the patient having swooned. On the films taken, however, it was observed that the ureter was contracted around the catheter and that no opaque medium was flowing alongside the latter. The renal pelvis would not take more than barely 4 cc.

Operation, Jan. 19, 1940, *Denervation of right kidney.* No abnormally mobile kidney. Pelvis and ureter of normal appearance in the main. The ureter is powerfully contracted. No kinking or stricture of the ureter could be detected, nor any adhesions or crossing of abnormal vessels.

Postoperative course: Completely uneventful. Returned home on tenth day.

Follow-up examination: The pain had completely vanished. Normal cystoscopical finds. The urine from the denervated kidney came at a distinctly quicker drip rate than from the left side. Nothing pathologic in the sediment.

Repetition of pain reproduction test: Still not the least pain or discomfort after injection of 20 cc. saline solution on right side.

After the operation the patient was free from symptoms for about half a year. Then she began to experience some discomfort again, though not of the same nature as before. She now states that her present attacks come on once or twice daily and that they usually begin with a feeling of nausea, a blackening before the eyes as if she were about to faint. She is working as a domestic servant, and when these attacks come on she must sit down on a chair and lean her head forwards for some minutes, after which the symptoms vanish entirely. In association with this intense feeling of weakness she usually also feels stabbing pains of an indefinite character, sometimes in one side of the abdomen, sometimes in the other, though generally on the right side and then perhaps somewhat more anteriorly than before the operation. They

are never combined with any form of strangury. The patient has also become exceedingly nervous, is prone to get uneasy, to weep, etc. Her menses have also become very irregular as regards interval, duration and quantity.

The patient was admitted for re-examination in January, 1941. She was then very neurotic, but otherwise nothing pathological was found at a thorough examination.

In order to ascertain whether any recidivation from the denervated kidney was present a re-examination of the urinary tract was made. Urography showed exactly the same picture as at the previous examination, and the cystoscopic findings were also normal this time. There was nothing pathologic in the urinary sediment. At a pain reproduction test the patient was still unable to trace the least pain or discomfort from the renal region after 20 cc. had been injected.

During the patient's stay in hospital a couple of attacks were observed and the character of these suggested the possibility of an affection of the biliary passages. For this reason cholecystography was performed, which showed good filling and good shape of the gall-bladder but a great delay in the emptying time.

In view of these findings, it was assumed that a spastic state of Oddi's sphincter was present. Treatment with eupaverin in small doses seemed to have a very favourable effect, and the patient was therefore discharged.

After a month she returned, however, complaining of continued pains. She was then so distressed by these that she begged for an exploratory operation.

On March 6, 1941, an *exposure of the gall-bladder* was therefore done. This organ was found to be distended and non-compressible. On further exploration it was found that the long and narrow cystic duct had an S-shaped kink, caused by abundant adhesions. When these were loosened, so that the cystic duct could be stretched, the gall-bladder readily emptied. Evidently a kind of water seal was present. The operation was finished off by an ordinary cholecystectomy, after which the entirely unaffected appendix was also extirpated.

At a follow-up examination in October, 1941, it was found that the patient had remained perfectly free from pain. At the final follow-up in April, 1944, the patient was unable to present herself for direct examination. She wrote, however, that there had been no signs of the pains in the renal tract, but that on solitary occasions she had been subject to attacks of the same abruptly insistent nausea as was described above in connexion with the patient's second admission to hospital. No notable pains occurred, however, in association with these attacks.

The case described has reference to a patient with attacks of pain, mainly localized to the right side of the abdomen, coming on at ever shortening intervals and increasing in intensity. After denervation of the kidney the patient was free from pain; half a year later, however, she developed similar symptoms again.

Radiological and operative evidence was then found of pathological conditions in the biliary system. After cholecystectomy the patient was permanently free from her symptoms. In view of this the question naturally arises whether the patient's distress had not been due all the time to her cholecystopathy, and hence that the diagnosis of sympatheticotonia renalis had been an erroneous one, so much the more as the purely objective finds from the kidney were unusually little pronounced at the X-ray examination and at the operation. However, it must be observed that the patient's attacks of pain had to some extent been of two different types. Those attacks to which she had been subject before the kidney operation had their special character and were of exactly the same type as the pains which arose on distension of the renal pelvis with common salt solution after even so unusually a small amount as 3—4 cc. After the denervation, the pains of just this type vanished. Those attacks which began to appear half a year later were of a somewhat different character and were cured after cholecystectomy. Certainly some relatively gross anatomical changes were observed at this operation, but the whole type of the attacks would nevertheless seem to point rather to a dyskinesia of the biliary passages as their ultimate cause.

Probably the situation may be interpreted thus, that this very sympathetico-tonic patient possessed an uncommon tendency to spastic conditions of the vegetatively innervated, non-striated sphincter muscles. At first, then, this spastic tendency affected the annular muscles in the calyces and pelvis of the right kidney. This morbid state was relieved by the denervation of the kidney. After some time similar spastic conditions arose in the sphincter Oddi. They could be overcome in the main by the operation on the biliary system. None the less, as the conditions are not perfectly clear, I have, as already mentioned, preferred to denote the result of the renal denervation in this case as dubious.

Can Denervation of the Kidney Cause Injury to the Kidney or other Complications?

An account of the results of renal denervation would not be complete without some reference to this question. The matter has already been discussed in detail in my previous paper, in which the view was put forward that no such injury is demon-

strable. What is therefore primarily to be considered on this occasion is whether the latter follow-up examinations or the experiences gained from new cases are of a nature to modify this conception.

It may be stated that such is not the case. As mentioned above, all the cases have been examined after the operation at least once, mostly several times, by means of cystoscopy and ureteric catheterization, and in every case, with a single exception, the kidney operated upon has functioned irreproachably and produced a normal urine with a normal rate of drip, in some cases a somewhat increased rate. The only exception has already been discussed in my previous paper (page 180). It was a case in which at the operation ligatures had to be placed on a couple of relatively large branches of the renal artery, with the result that the renal function suffered considerably for a time. A year later, however, the kidney again produced a completely normal urine, although the rate of secretion was much lower than that of the other kidney. This has caused no discomforts of any kind up to the time of the follow-up examination five years later.

No complications of a serious nature connected with the operation have been observed either. In the case just described there was a protracted sluggish secretion from the wound. In another case there arose for a few days a limited basal pneumothorax, caused by a small rift that happened to be made in the pleura at the resection of the twelfth rib. In spite of this the patient was able to get up four days after the operation and to return home on the 13th day. In one case the patient had a mild pleural irritation on the non-denervated side. There were no other troubles. Otherwise the course during and after the operation has been entirely uneventful.

Conclusion.

The author's follow-up examinations of cases of renal sympathetico-tonus previously operated upon and his experiences from new cases seem to show that if a reliable diagnosis can be arrived at, with the aid of rules set up in the author's previous paper, a very good result can be confidently expected from renal sympathectomy. The operation may be described as harmless to the kidney, and the risk of complications is very small.

Summary.

Follow-up investigation of 18 cases of renal sympathetico-tonus treated by denervation of the kidney.

Eleven of these cases have been described in detail in an earlier paper of the writer's, in connexion with an account of the pathological anatomy and symptomatology of this disease. These cases have now been re-examined after five years. The result must be denoted as good, all the patients having been completely and lastingly relieved of their earlier attacks of pain.

Seven further cases have been subsequently treated on the same principles. The time of observation for these is certainly shorter, but here, too, no recurrence of the attacks of pain has been observed in a single case. For one of these cases the result has nevertheless been regarded as dubious, in that the possibility of an erroneous diagnosis having been made can not be excluded.

The operation was on no occasion followed by serious complications and caused no injury to the denervated kidney. At the follow-up examinations the denervated kidneys were found to produce a normal amount of normal urine. In one case only the rate of secretion was diminished.

Zusammenfassung.

Nachuntersuchung an 18 Fällen von renalem Sympathetikotonus, behandelt mit Denervation der Niere.

11 dieser Fälle wurden in einer früheren Arbeit von Verf. gelegentlich eines Berichtes über die pathologische Anatomie und das Symptomenbild bei dieser Krankheit eingehend beschrieben. Diese Fälle sind jetzt nach 5 Jahren nachuntersucht worden. Das Ergebnis ist als gut zu bezeichnen, indem sämtliche Kranken von ihren früheren Schmerzanfällen vollständig und dauernd frei sind.

Weitere 7 Fälle sind seither nach den gleichen Prinzipien behandelt worden. Die Beobachtungszeit derselben ist kürzer, aber auch hier wurde in keinem einzigen Falle ein Wiederauftreten der Schmerzanfälle beobachtet. Bei einem dieser Fälle ist das Ergebnis jedoch als zweifelhaft angesehen worden, indem die Möglichkeit einer Fehldiagnose nicht ausgeschlossen ist.

Der operative Eingriff war niemals von ernststen Komplikationen begleitet und brachte keine Schädigung der denervierten Niere

mit sich. Bei der Nachuntersuchung stellte sich heraus, dass diese Nieren eine normale Harnmenge produzierten. Nur in einem Falle war die Sekretionsgeschwindigkeit herabgesetzt.

Résumé.

Résultats des examens de contrôle portant sur 18 cas d'hyper-sympathicotonie rénale traités par énervation du rein.

Onze de ces cas ont été décrits avec tous les détails dans un article antérieur de l'auteur, qui expose en même temps l'anatomie pathologique et le tableau symptomatique de cette affection. Ces cas ont maintenant été réexaminés après 5 ans. Le résultat obtenu doit être déclaré bon puisque tous ces malades ont été complètement et durablement débarrassés de leur anciennes crises douloureuses.

Sept autres cas ont, par la suite, été traités selon les mêmes principes. La durée d'observation, pour eux, est plus courte, mais chez aucun, ici non plus, on n'a noté le retour des crises de douleurs. Tout de même, dans l'un de ces cas le résultat fut considéré comme douteux, attendu que la possibilité d'une erreur de diagnostic n'est pas exclue.

L'intervention opératoire n'a jamais entraîné de complications sérieuses, ni causé aucun dommage au rein énervé. Lors des examens de contrôle on constata que les reins opérés produisaient une quantité normale d'urine normale. Dans un seul des cas la vitesse de sécrétion était diminuée.

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Aus der chirurgischen Abteilung des St.-Göran-Krankenhauses
in Stockholm.
(Chef: Prof. A. TROELL.)

Blutjodstudien.

Von

THORE OLOVSON.

Seit Einführung der ersten Mikromethode zur quantitativen Jodbestimmung sind zwanzig Jahre vergangen. Bei älteren Verfahren waren zur Jodanalyse etwa 200—300 ccm Blut erforderlich. Die neue Mikromethode ermöglichte es, mit nur 10 ccm exakte Bestimmungen ausführen. Der Urheber der Methode war v. FELLENBERG. Dieselbe öffnete wie ein Schlüssel das Tor zum klinischen Forschungsfelde der Blutjodstudien.

In den auf 1924 folgenden Jahren wurden eine Reihe bedeutungsvolle, grundlegende Untersuchungen veröffentlicht (GLIMM und ISENBRUCH, LUNDE, CLOSS und PEDERSEN, REITH, VEIL und STURM, PFEIFFER, BILLMANN, SCHWAIBOLDT, WIDMANN, MÖBIUS u. a.). Das Prinzip der Fellenberg'schen Methode ist folgendes: das Blut oder die organische Substanz wird nach Zusatz von Alkali bei hoher Temperatur verascht. Das Jod verbindet sich dabei mit Kalium zu Jodkalium, welches in Alkohol löslich ist. Nach Alkoholextraktion wird alsdann das Jod titrimetrisch bestimmt. Das Verfahren hat gewisse Schwächen, u. a. die, dass die Veraschung offen bei hoher Temperatur stattfindet, wodurch die Möglichkeit unkontrollierbarer Jodverluste gegeben ist. Die Methode ist ferner zeitraubend und schwer zu beherrschen.

Die Fellenberg'sche Methode, welche auf diesem Gebiet bahnbrechend gewirkt hat, ist heute in grossem Umfang verlassen. Heutzutage bedient man sich meistens eines von LEIPERT 1933 angegebenen Verfahrens oder Modifikationen desselben. Die Leipert'sche Methode wird zum Unterschied von der Fellenberg'schen als die feuchte bezeichnet. Auch bei ihr arbeitet man mit 10 ccm

Blut, dessen organische Substanz mit Chrom-Schwefelsäure verbrannt wird. Das Jod wird in nicht flüchtige Jodsäure umgewandelt. Durch Reduktion mit arseniger Säure wird das Jod freigemacht, dann in eine Vorlage mit alkalischem Inhalt hinübergetrieben und titrimetrisch bestimmt. Die ganze Prozedur geht in einem geschlossenen System von Glasrohren und Kolben vonstatten.

Das Leipertsche Verfahren ist einfacher auszuführen und liefert zuverlässigere Werte. Jegliche Blutjodanalyse ist jedoch schwer und zeitraubend, auch diese. Jede Bestimmung dauert ca. 3 Stunden. Die Anforderungen an Jodfreiheit der Reagenzien und Utensilien sind hoch.

Namentlich nach der Einführung der Leipertschen Methode, also während des letzten Jahrzehnts, sind die klinischen Blutjoduntersuchungen in etwas grösserem Umfang betrieben worden. Wenn auch die Resultate der Blutjodforschung nicht eine so wichtige Rolle bei Strumafragen gespielt haben, wie man es sich anfangs vorgestellt hatte, haben sie doch für die Kenntnis des Jodumsatzes grosse Bedeutung erlangt und unser Wissen über die Beziehung zwischen diesem und der Schilddrüse erweitert.

Dass das Blut normalerweise kleine Jodmengen enthalten kann, war bereits durch Untersuchungen Anfang unseres Jahrhunderts bekannt (BLUM und GRÜTZNER 1913, KRAUS 1915, WINKLER 1915, WINTERSTEIN 1918, KENDALL und RICHARDSSON 1920, MAC CLENDON 1924, BUCHHOLT 1924). Man hielt aber das Auftreten dieser kleinen Jodmengen im Blut für alimentär bedingt. Durch Untersuchungen der späteren Jahre ist jedoch erwiesen worden, dass das Blut konstant Jod enthält. Das Jod kommt im Blut teils anorganisch, in Form von Alkalisalzen, teils organisch an Eiweissstoffe und Fett gebunden vor. Nach Angabe gewisser Forscher (STURM, LUNDE u. a.) soll das organische Jod, die alkoholunlösliche Fraktion, welche bis ca. 30 % des Gesamtjods beträgt, das eigentliche aktive Prinzip der Schilddrüse darstellen. Andere bestreiten dies.

Zur Zeit liegen Untersuchungen über den normalen Jodspiegel des Blutes in recht grosser Anzahl vor. Mit gewissen nach oben und unten schwankenden Grenzwerten haben sich ziemlich übereinstimmende Werte ergeben. Die Differenzen finden ihre Erklärung zum Teil in der Verwendung verschiedener Untersuchungsmethoden. In Tab. 1 habe ich einige Normalwerte aus dem Schrifttum zusammengestellt.

Tab. 2.
Blutjodwerte bei Normalfällen.

Geschlecht	γ%	
m.	5.9	
w.	8	7.4
w.	9.3	10.1
m.	6.4	
w.	6.8	7.6
m.	6.3	
m.	13.5	
w.	9.1	10.3
m.	14.8	
m.	10.5	
w.	8.9	10.5
w.	7.2	
m.	11.8	12.7
w.	16.5	17
w.	11.8	10.5
m.	11.4	
w.	12.7	
m.	12.7	14.8
w.	6.3	
w.	10.7	
m.	8.0	9.7
w.	16.9	
m.	12.3	
w.	19.0	
w.	6.3	6.3
m.	8.5	6.8
w.	5.1	
w.	10.2	
w.	12	

Grenzwerte 5.1—19 γ%. Mittelwert 10 γ%.

Fragestellungen nicht um die absoluten Werte handelt. Die Hauptsache ist, dass die Jodwerte in demselben Laboratorium auf einer einigermassen konstanten Höhe liegen.

Es ist also erwiesen, dass Jod ein physiologisch, regelmässig vorkommender Bestandteil des Blutes ist, und dass der normale Blutjodspiegel eine gewisse Konstanz aufweist. Wahrscheinlich ist es so, dass die Aufrechterhaltung des Blutjodspiegels nach ähnlichen Gesetzen vonstatten geht, wie wir sie von anderen Blutkonstanten, z. B. Blutzucker, Kalk usw. her kennen. Im Hunger hält das Blut seinen Jodspiegel fest (VEIL und STURM). Gewisse kleinere jahreszeitliche Schwankungen kommen vor (NITESCU, BINDER, VEIL und STURM). Die Variationen sind indessen gering, sie betragen nur 4—5 γ. Interessant ist der Umstand, dass sich der Jodgehalt des Blutes während des weiblichen Genitalzyklus ändert. Beim Beginn der Menstruation tritt nämlich

ein Anstieg des Blutjods ein (SCHERINGER, VEIL und STURM, LEIPERT, MAURER und DIETZ). Eine Steigerung lässt sich auch während der Schwangerschaft konstatieren (BACKELMANN und SCHERINGER). Gewisse psychische und nervöse Reaktionen, heftige Gemütsbewegungen ohne Erhöhung des Grundumsatzes werden mitunter von einer Zunahme des Blutjods begleitet (WITTKOWER, TIMPE, SCHITTENHELM und EISLER). Manche Medikamente, wie Adrenalin, Atropin, Morphin, steigern den Jodgehalt des Blutes, andere, beispielsweise Cholin, Pilocarpin, Digitalis und Insulin, bringen ihn zum Sinken.

In bezug auf den Regulationsmechanismus des Blutjodspiegels herrscht noch grosse Unklarheit. Die vorstehend angeführten Beobachtungen machen ersichtlich, dass der Blutjodspiegel unter dem Einfluss endokriner und vegetativer Faktoren steht, doch ist ganz offenbar, dass die Schilddrüse als Regulator des Jods eine zentrale Stellung einnimmt. Da man ferner gefunden hat, dass die Tätigkeit der Schilddrüse sowohl von der Hypophyse (thyreotropes Hormon) als auch vom autonomen Nervensystem abhängt, muss man damit rechnen, dass die Regulation des Jodgehalts im Blut unter Beteiligung dieser Faktoren erfolgt.

Die wichtige Rolle der Schilddrüse im Jodhaushalt des Organismus erhellt u. a. aus der Tatsache, dass diese endokrine Drüse das jodreichste Organ des Körpers ist. Ein Vergleich zwischen dem Jodgehalt beispielsweise des Gehirns und der Schilddrüsensubstanz 3500 γ (LAHEY). Es ist jedoch zu beachten, dass die Thyreoidea nur einen Bruchteil der gesamten Jodmenge des Körpers enthält. In der Muskulatur befinden sich z. B. etwa 50 % des Gesamtjods. Auch Haut und Eierstöcke sind verhältnismässig jodreich.

Der regelnde Einfluss der Schilddrüse auf den Jodgehalt des Blutes macht sich u. a. auch nach der Totalexstirpation der Drüse bemerkbar (CURTIS, BARRON, PHILIPS, STURM). Sowohl klinisch wie experimentell ist festgestellt worden, dass mit der Entfernung der Thyreoidea die Regulation des Jodumsatzes aufhört. Der Blutjodspiegel verliert seine Konstanz und wird von exogenen Einflüssen abhängig. Eine eindeutige Beziehung zwischen Schilddrüse und Blutjodspiegel gibt sich ferner darin zu erkennen, dass Änderungen des funktionellen Verhaltens der Drüse auch beträchtliche Veränderungen des Jodgehalts im Blut zur

Folge haben. Dieser Umstand besitzt grösste Bedeutung für die Strumaforschung.

Ein Zusammenhang zwischen Basedow, Schilddrüse und Jodumsatz besteht offenbar; welche Rolle aber die Thyreoidea hierbei spielt, ist noch unklar. Auf der einen Seite wird der Schilddrüse eine entgiftende Wirkung auf intermediär entstehende Stoffwechselprodukte zugeschrieben, auf der anderen hält man die Drüse für die Bildungsstätte eines Stoffwechselhormons. Klinische und experimentelle Untersuchungen sprechen dafür, dass die Ursache der Basedowschen Krankheit in einer gesteigerten Ausschwemmung des Kolloids der Drüse und der in diesem enthaltenen Drüsenprodukte zu suchen ist. Der Jodgehalt des Blutes und der Schilddrüse weisen bei diesem Leiden typische Veränderungen auf. Nach SAEGESSER beträgt der Jodgehalt der Thyreoidea bei Basedowkranken nur ungefähr $\frac{1}{10}$ — $\frac{1}{14}$ des Jodgehalts der normalen Drüse, und der Blutjodspiegel ist bei diesen in den meisten Fällen deutlich höher als bei Gesunden.

Dementsprechend glaubte man im Anfang der Blutjodforschung, im Blutjod, und zwar namentlich in der Eiweisskomponente desselben, ein Mass für die Funktion der Schilddrüse zu finden. Die ersten Untersuchungsergebnisse schienen auch Belege für diese Anschauung zu liefern; spätere umfassende Versuche zeigten aber, dass dies nicht zutrifft. Der Blutjodspiegel ist kein direkter Massstab für die Schilddrüsenfunktion. Der Jodgehalt des Blutes ist kein Indikator für die Menge des Thyreoideahormons. Das Blutjod steht auch nicht in unmittelbarer Beziehung zum Grade der klinischen toxischen Erscheinungen beim Basedow und ebenso wenig zu den Grundumsatzwerten.

Meine Blutjoduntersuchungen erstreckten sich u. a. auch auf eine Reihe von Basedowfällen. Die Resultate derselben sind in Tab. 3 zusammengestellt.

Bei keinem der Fälle war vor der Blutentnahme Jod verabreicht worden. Die Proben wurden auf nüchternen Magen entnommen, an demselben Tage, an welchem die Grundumsatzbestimmung stattfand, deren Wert neben dem Jodwert in der Tabelle angegeben ist.

Zieht man die obere Grenze der Norm bei 19 γ %, so ergibt sich, dass 22 von der 32 Fällen einen erhöhten Jodgehalt des Blutes aufweisen (68 %), die übrigen 10 Werte, welche im Bereich des Normalen liegen. Irgendein Parallelismus zwischen Grundumsatzwerten und Blutjodspiegel ist nicht zu konstatieren.

Tab. 3.

Blutjodwerte bei Basedowfällen.

Geschlecht	Alter	Grundumsatz- wert in %	Blutjodwert in $\gamma\%$
w.	35	+ 74	31.4
w.	17	+ 97	11.9
w.	59	+ 54	16.1
w.	35	+ 48	16.5
w.	25	+ 64	149.0
w.	30	+ 36	13.5
w.	46	+ 42	10.6
w.	41	+ 74	30.0
w.	52	+ 62	27.5
w.	48	+ 50	12.3
w.	53	+ 90	16.5
w.	16	+ 48	13.5
w.	31	+ 43	7.6
w.	56	+ 55	29.6
w.	56	+ 113	85.0
w.	53	+ 55	17.0
w.	19	+ 50	27.6
w.	45	+ 66	27.8
w.	37	+ 43	40.5
w.	17	+ 54	44.0
w.	50	+ 22	27.6
w.	27	+ 25	38.0
w.	38	+ 71	40.5
w.	32	+ 39	29.6
w.	19	+ 50	67.0
w.	36	+ 22	37.0
w.	44	+ 79	38.0
w.	44	+ 23	24.0
w.	66	+ 155	46.0
w.	47	+ 46	31.0
w.	61	+ 55	20.0
w.	24	+ 37	80.0

Der höchste Wert in dieser Untersuchungsreihe ist 149 $\gamma\%$. Im Schrifttum schwanken die Angabe über den Höchstwert zwischen 50 und 276 $\gamma\%$ (SCHITTENHELM: 90 $\gamma\%$, SCHNEIDER und WIDMANN: 256 $\gamma\%$, VEIL und STURM: 50 $\gamma\%$, HIRSCH: 50 $\gamma\%$, LUNDE und Mitarbeiter: 276 $\gamma\%$).

Die Resultate dieser Blutjoduntersuchungen bei Basedowfällen stimmen mit anderen Analysenresultaten im Schrifttum u. a. insofern überein, als keinerlei Zusammenhang zwischen Blutjod- und Grundumsatzwerten zu entdecken ist. Das Ergebnis ist also, dass der Blutjodspiegel weder vom klinischen Bilde noch von der Intensität des Stoffwechsels abhängig ist. Umfassende klinische Untersuchung haben gelehrt, dass der Jodgehalt des Blutes gewöhnlich bei Kranken mit Hyperthyreoidismus erhöht und bei solchen

mit Hypothyreodismus herabgesetzt ist. Diesbezüglich wird auch der Bestimmung des Jodgehalts im Blut ein bestimmter differentialdiagnostischer Wert zuerkannt.

Man hat indessen bei einer gewissen, kleineren, Anzahl von Fällen mit ausgeprägtem Hyperthyreoidismus Blutjodwerte gefunden, welche durchaus in den Grenzen der Norm lagen, was man auch in meiner Untersuchungsreihe bemerken kann. Mit dieser Frage haben sich namentlich amerikanische Forscher beschäftigt; PERKIN und LAHEY machten geltend, dass derartigen atypischen, niedrigen Werten beim Basedow eine interessante prognostische Bedeutung zukomme. Diese Autoren behaupten, der Jodgehalt des Blutes lasse beim Basedow einen gewissen Zusammenhang mit der Dauer der toxischen Symptome erkennen, und zwar in der Weise, dass der Jodgehalt bei Fällen mit verhältnismässig kurzer Dauer erhöht ist; den normalen Blutjodwerten soll man dagegen denjenigen bei Basedowfällen begegnen, bei welchen die Krankheitserscheinungen längere Zeit bestanden hatten.

In Tab. 4 ist das vorliegende Basedowmaterial mit Rücksicht auf die Dauer der Symptome in Gruppen eingeteilt. Dabei wird ein allmähliches Sinken des Blutjods bei zunehmender Krankheitsdauer deutlich ersichtlich. PERKIN und LAHEY ziehen die Grenze für das Vorkommen erhöhter Blutjodwerte bei einer Dauer von 9—12 Monaten. Hat die Krankheit längere Zeit bestanden, so hält sich der Blutjodspiegel bei normalen Werten.

Als Erklärung für diese interessanten Beobachtungen ist folgendes angeführt worden. Man hat durch Harnjodbestimmung gezeigt (PERKIN), dass Fälle von Hyperthyreose mit erhöhtem Blutjodwert 0.25—1 mg Jod pro Tag ausscheiden. Da es sich bei dem zugeführten Jod gewöhnlich im Mittel um erheblich kleinere Mengen als 0.25 mg handelt, befinden sich diese Patienten infolgedessen in einer negativen Jodbilanz. Es liegt da die Annahme nahe, dass die Schilddrüse, wenn das Hyperthyreosesyndrom eine längere Zeit anhält, nach und nach ihren Vorrat an Jod abgibt. Nachdem dieser Zustand erreicht ist, sollen Blutjodgehalt und Harnjodgehalt normal werden. Die Dauer der Krankheit soll mithin den Jodgehalt des Blutes bedingen. Ein normaler Blutjodwert wäre also das Zeichen eines schwereren Krankheitszustands, mit eingreifenderen Veränderungen des Jodhaushalts, eines verhältnismässig ungünstigen Zustands. PERKIN und LAHEY sehen demgemäss in normalen Blutjodwerten beim Basedow ein prognostisch ungünstiges Merkmal und sagen, dass derartige Fälle

Tab. 4.

Beziehung zwischen Jodgehalt des Blutes und Dauer der Symptome beim Basedow.

Dauer der Symptome	Grundumsatzwert in %	Blutjodwert	Blutjodmittelwert
1 Monat	+ 64	149	
2 Monate	+ 54	44	
	+ 74	30	
	+ 48	13.5	45 %
	+ 113	85	
	+ 25	38	
	+ 50	67	
	+ 79	38	
3 Monate	+ 62	27.5	
	+ 50	27.6	39.9 %
	+ 43	40.5	
	+ 23	24	
	+ 37	80	
4—6 Monate	+ 74	31.1	
	+ 90	16.5	
	+ 55	29.6	
	+ 71	40.5	32.4 %
	+ 46	13	
	+ 155	46	
	+ 66	27.8	
	+ 22	37	
1—mehrere Jahre	+ 54	16.1	
	+ 48	16.5	
	+ 42	10.6	
	+ 36	13.5	15.5 %
	+ 50	12.3	
	+ 55	20.0	
	+ 43	7.6	
	+ 97	11.9	
	+ 55	17.0	
	+ 39	29.6	

der Behandlung gegenüber resistenter sind, und dass die Erfolge der Therapie bei ihnen nicht ebenso gut seien wie bei Fällen mit erhöhten Blutjodwerten.

Grosses Interesse besitzt ferner das postoperative Verhalten des Blutjodspiegels sowie die Beziehung desselben zu Rezidiven und postoperativem Myxödem. Meine Untersuchungen hierüber sind noch nicht zahlreich genug; daher mögen diejenigen von PERKIN und LAHEY angeführt werden. Diese Autoren bestimmten bei 256 Fällen von Hyperthyreoidismus den Jodgehalt des Blutes teils vor der Operation, teils im Laufe eines Jahres nach

derselben in Abständen von drei Monaten. Auf Grund der Resultate teilten sie ihr Material in drei Gruppen ein:

Gruppe I: Fälle, bei welchen der Blutjodwert präoperativ erhöht war und postoperativ recht bald (binnen 3 Monaten) normal wurde,

Gruppe II: Fälle, bei welchen der Blutjodwert präoperativ normal war und nach der Operation stieg,

Gruppe III: Fälle in geringer Anzahl mit sowohl vor wie nach der Operation normalem Jodgehalt des Blutes.

Tab. 5 (nach PERKIN).

	Anzahl Fälle	Geheilt %	Transitorisches und dauerndes Myxödem %	Persistierender und rekurrenter Hyperthyreoidismus %
Gruppe I.....	170	91.3	8.8	0
Gruppe II.....	61	77.1	3.3	19.6
Gruppe III.....	25	96.0	4.0	0

Die praktische Konsequenz dieser Beobachtungen wäre die, dass bei allen Fällen von Basedow, bei welchen der Jodgehalt des Blutes normal ist, eine radikalere Resektion am Platze ist, um einer sich in dieser Gruppe von Fällen bemerkbar machenden Rezidivneigung vorzubeugen. Ein radikaleres Vorgehen wird auch dadurch gerechtfertigt, dass in dieser Gruppe das postoperative Myxödem selten zu sein scheint. Demgegenüber würde ein weniger weitreichender Eingriff bei den Fällen geboten sein, wo der Jodgehalt des Blutes erhöht ist, da die Rezidivtendenz hier gering, die Neigung zum Myxödem aber grösser ist.

Falls weitere Untersuchungen die hier wiedergegebenen Feststellungen bestätigen würden, so wäre damit ein wertvoller Einblick in die Frage des Jodumsatzes beim Basedow gewonnen, sowie überdies eine willkommene Richtschnur für unser chirurgisches Handeln.

Die präoperative Lugolbehandlung beim Basedow hat eine Zunahme des Jodgehalts der Schilddrüse zur Folge. SÄGESSER fand, dass dieser auf etwa das 13fache stieg. Das Verhalten des Blutjods während dieser Behandlung geht aus Tab. 6 hervor, welche die Resultate von Blutjodbestimmungen bei einer Reihe von Basedowfällen vor der Lugolbehandlung und beim Abschluss derselben unmittelbar vor der Operation enthält.

Tab. 6.

Blutjodspiegel vor und während der Lugolbehandlung.

Grundumsatzwert in %	Blutjodspiegel	
	vor d. Lugol- behandlung	während d. Lugol- behandlung
+ 97	11.9	102
+ 54	14.4	165
+ 36	11.4	55
+ 42	9.3	204
+ 74	30.0	242
+ 62	27.5	111
+ 43	6.8	120

Bei den untersuchten Patienten zeigt der Jodspiegel durchweg eine markante Steigerung nach der Lugolbehandlung.

Zusammenfassung.

Nach einer kurzen Übersicht über die Prinzipien der Mikromethoden zur quantitativen Blutjodanalyse berichtet Verf. über eigene Untersuchungen. Verf. findet, dass die Grenzwerte des normalen Blutjodspiegels zwischen 5.1 und 19 $\gamma\%$ liegen, mit einem Mittelwert von 10 $\gamma\%$. Der Jodgehalt des Blutes wurde bei 32 Fällen von Struma diffusa Basedowi untersucht, und dabei wurde in 68 % der Fälle ein Anstieg über die Norm hinaus konstatiert. Zwischen dem Jodgehalt des Blutes und den klinischen toxischen Symptomen besteht kein Parallelismus, ebenso wenig zwischen Blutjod- und Grundumsatzwerten. Die Jodgehalt des Blutes steht insofern in einer gewissen Beziehung zur Dauer der Symptome beim Basedow, als er mit steigender Dauer abzunehmen scheint. Während der präoperativen Lugolbehandlung stellte Verf. einen starken Anstieg des Jodgehalts im Blut fest.

Summary.

A brief review of the principles applied by the advocates of microdetermination in quantitative analysis of blood iodine is followed by a report on the author's own investigations. The author discovered that the borderline values for normal blood iodine lie between 5.1 and 19 gamma percent, with a mean value

of 10 gamma percent. The blood iodine content was studied in 32 cases of Struma diffusa Basedowi and was found to be higher than normal in 68 percent. No parallelism was found between the blood iodine content and the clinical toxic symptoms or between the blood iodine content and the metabolic values. There was a certain relationship between the blood content and the duration of the symptoms in Basedow's disease, the former appearing to decrease in proportion to the length of the disease. The author found a pronounced rise in the blood iodine content during the preoperative Lugol treatment.

Résumé.

Après une courte revue des principes de la microméthode utilisée dans l'analyse quantitative de l'iode du sang l'auteur rend compte de ses recherches personnelles. Il constate que les limites de la teneur normale du sang en iode sont entre 5.1 et 19 gamma %, avec un chiffre moyen de 10 gamma %. Il examine la teneur du sang en iode dans 32 cas de goître de Basedow diffus et observe une élévation de la teneur au-dessus de la normale chez 68 % d'entr'eux. Il n'y a pas de parallélisme entre la teneur en iode et les symptômes cliniques de faxicité, pas plus qu'entre la richesse en iode et les chiffres du métabolisme. La teneur en iode offre un certain rapport avec la durée des symptômes dans le Basedow en ce sens qu'elle semble diminuer avec la durée de la maladie. Pendant le traitement préopératoire du Lugol l'auteur constate une forte élévation de la teneur du sang en iode.

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From the Orthopedic Clinic (Vanförestalten), Karolinska Institutet,
Stockholm.

(Head: Prof. S. FRIBERG.)

Arthroplasty in Arthritis Deformans of the Hip Joint.

By

ANDERS KARLÉN.

Arthroplastic procedures on the hip joint are one of the most serious forms of operation undertaken in orthopedic surgery, and if they are to be attempted at all the results obtained should unconditionally be such as to justify both the risks involved and the great loss of time entailed for the patients. To judge from the literature, the results appear to be extremely variable, and while one author refuses almost categorically to admit their usefulness, the next considers that excellent results can be achieved. Surgeons both in Germany and in France are still of the opinion that this procedure is of value, while in America and England, on the other hand, owing to the poor results reported there, it has been largely abandoned in favour of the arthrodesing operation. There is some difference of opinion as to the scope of the operation covered by the term arthroplasty. In the present article, the term has been used only in the sense of a total arthroplasty on the joint: excisions of the head, reconstruction operations of the type described by WHITMAN, and other such interventions, will not be included.

Arthroplastic operations can be carried out according to two different methods, the distinction between them being that in the one case the material interposed is autogenous while in the other some material foreign to the body is used.

The first-mentioned method was worked out originally in 1905, by MURPHY, who interposed a fascia-lata flap. Since his time, this form of arthroplasty has been in wide use, although no particularly comprehensive reviews have been published on the re-

sults achieved with it. HILDEBRAND, in 1921, mentioned the results obtained in 15 cases. Of these, 4 were too recent to provide reliable information, and one patient could not be traced for a re-examination. Of the remaining 10 cases, 3 had no discomfort at all, 5 still had constant pain, and one pains on exertion; in the tenth case there is no mention of whether there was pain or not. As regards the results, HILDEBRAND stated: "that the patient's condition had been much improved by the operation and the improvement had lasted for several years. There was no reason to fear a recurrence". In 1928, BERGMAN re-examined HILDEBRAND's patients who had been treated by arthroplasty. In all, 56 hips had been operated upon up to that time but only 20 could be traced. In 3 of these cases the operation was too recent to give a trustworthy result. In the remaining cases, 13 were found to be improved and in 4 the condition of the hip was unchanged or had deteriorated. It should be noted, however, that among the 13 who were described as being improved only 8 had satisfactory joint motion while in 3 the mobility was very limited and in 2 there was ankylosis. ALBEE reported in 1921 on the results he had obtained in four arthroplastic operations on patients with arthritis deformans of the hip, stating that in none of these had he achieved as good an effect as he had from arthrodesis, in mono-articular affections. In 1922, PUTT maintained that the chances of success with an arthroplasty were distributed in the following order among the joints most commonly submitted to the operation, viz. a) the elbow joint, b) the knee joint, c) the mandibular joint, and d) the hip joint. Thus, the hip joint, in his opinion, gave the worst results. LEXER, who interposed a flap of fat instead of a fascia-lata flap, stated in 1925 that in 11 cases of coxa vara with arthritis deformans he had had success in 9 and failures in 2 instances. Finally, FALTIN, in 1927, recommended arthroplasty for quite young patients and other well-preserved individuals, and up to that date he had used the operation in 13 cases. Of these one was too recent to permit judgment to be passed, while with the others the following results had been achieved: 2 had died and 6 were improved, and in 4 the effect was poor. Up to 1924, CAMPBELL had performed 110 arthroplasties, but only in one case had it been done to correct bony ankylosis resulting from osteo-arthritis. CAMPBELL considered the most suitable age for the procedure to be between 18 and 30 years, although he thought its use was justified up to the age of 55. In 1926 he wrote

as follows with regard to arthritis deformans as a contra-indication to arthroplasty: "When the ankylosis is the result of a low-grade, progressive arthritis, as arthritis deformans, the procedure is justifiable only as an experiment after the process has apparently been arrested". In 1932 he made the following statement: "Arthroplasty should be employed as a selective measure especially in the weight-bearing joints. A stiff joint in a good position is more serviceable in strenuous occupation", and in 1934: "Although there have been a small number of successful cases in those with laborious occupations, the procedure should not be advised unless the individual is able to undergo rehabilitation if necessary". The difference of opinion regarding the value of arthroplastic procedures in arthritis deformans of the hip is well illustrated by the judgments passed by the following four authors. GROVES asserted in 1933 that arthroplasty could hardly come into question in patients with arthritis deformans in the hip seeing that this is too serious an operation to employ on tissues unsuitable for plastic work. McMURRAY maintained in 1934 that the average results achieved with arthroplasties on the hip joint were distinctly bad, and that in 5 cases out of 7 he had only succeeded in producing very poor joint movement and the patients were subsequently not even free from pain. PAYR, on the other hand, stated in 1939 that a total arthroplasty often gave excellent results, and HACKENBROCH also recommended the procedure in 1943 for patients in whom the arthritic lesions were mainly secondary and in whom the shape of the joint ends was fairly well preserved.

Not satisfied with the results shown by arthroplasty with autogenous material, SMITH-PETERSEN, in 1923, attempted to improve the operation by interposing foreign-body material. His idea was not a new one. Even at the end of the nineteenth and the beginning of the twentieth century it had been applied in connection with ankylosis of the mandibular joint (FÖRDEL 1895, ROSER 1898, ORLOW 1903), in animal experiments (CHLUMSKY 1900), and to relieve joint contractures (FROELICH 1904). At the Congress of Surgeons in Paris in 1913, BAUMGARTNER reviewed the results achieved by implanting foreign bodies, and summarized his views as follows: "L'interposition de corps étrangers, métalliques, organiques, résorbables ou non, n'a pas été suivi de beaucoup de succès, et les tentatives en sont aujourd'hui généralement abandonnées". SMITH-PETERSEN described his technique in 1939.

After having experimented with molds of many different substances, made ready in advance before the operation, he had decided to use vitallium, this being an alloy which, according to the findings of VENABLE and STUCK, is not injurious to the tissues. At the time his article was published 29 patients had been operated upon with good results, although it should be pointed out that the postoperative observation time in every instance was short. BAKER and WATERS published an article in 1942 on arthroplasty with vitallium molds, but owing to the wartime postal restrictions it has not been possible to procure it. The opinions expressed in the literature on the usefulness of the procedure directly contradict one another. At the Orthopedic Congress at Lund, in 1941, R. MAGNUSSON summed up his experience with 5 cases by saying: "that Smith-Petersen's plastic method is hardly likely to cause any better results to be obtained from arthroplastic operations on the hip joint, nor to increase the indications for the procedure". In the same year DICKSON wrote: "At the present time, in both the mono-articular hypertrophic type of arthritis of the hip and in ankylosis due to atrophic arthritis, the results of arthroplasty, using vitallium cups, are so promising that it bids fair to replace arthrodesis of the hip joint, which has up to the present time been the operation of choice in this type of cases".

At the Stockholm Orthopedic Clinic, up to the year 1943, arthroplasty had been used in 16 cases of arthritis deformans of the hip, the material interposed having consisted in 7 instances of a fascia lata and in 9 of a vitallium mold. Cases operated upon since that time have not been included in this article, in order that the postoperative observation time in every instance would be at least one year. One of the cases described here, however, does not fulfil this condition. The reason why this case has been included is that, when the last control examination was carried out, there was only rocking movement in the hip, and as, in addition, the roentgenogram revealed an apparently fully developed bone bridge between the upper acetabular rim and the greater trochanter, there seemed little likelihood that the patient's condition would improve. Two of the patients have not been re-examined owing to the fact that they did not present themselves as requested. As regards these cases, however, the postoperative observation time was 13 months, and in addition to this one of the patients had reported his condition by letter.

In 10 cases the etiology could be established. It consisted in 4 instances of epiphysiolysis of the femoral head, in 2 of congenital subluxation, in 2 of septic coxitis, in 1 of a reduced congenital luxation, and in 1 of fracture of the femoral neck. In the remaining 6 patients the cause could not be determined. Twelve of the patients had mono-articular and 4 bi-articular lesions. In 4 instances the acetabulum was found at the operation to be so poorly developed — shallow and steep — that it was made deeper in order that better support would be provided for the newly-formed head.

The symptoms which had been most predominant and which had caused the patients to be more or less unfit for work were pains in 9 cases, pains and stiffness in 2 cases, stiffness in 2, and a malposition in 2. Unfortunately, the hospital records only mention the fitness for work in 12 of the cases. Of these, 11 were totally incapacitated and one could do only light work.

The Clinic's material comprises 7 men and 9 women. The following occupations were represented among the men: Foreman, 1, motor mechanic, 1, office clerk, 1, farm hands, 3. In one instance the occupation is not stated. Two of the farm hands were among the cases with bi-articular lesions. One patient with mono-articular arthritis was 24 years old at the time of the intervention and was trained for a trade subsequently, and now works as a tailor. Among the women, 3 were housewives, one of them having bi-articular arthritis, and 4 were unmarried girls living at home, while in 2 instances there is no mention of the occupation, the only record being that they answered to the title of Miss.

Finally, as regards the material chosen for the arthroplasty, our policy has been to use fascia lata for young, hardy patients, and a vitallium mold for older patients or those with reduced powers of resistance. In the case of the fascia-lata arthroplasty, the actual operation is more extensive and takes a longer time to perform, and the subsequent treatment is also more exacting than after a mold arthroplasty. With regard to the age limits and the average age in the two groups, the limits for the procedure with a fascia lata were 16 and 43 years, and the average age not quite 29 years, while for the mold arthroplasty the corresponding figures were 19 and 64, and 42 years, respectively. The oldest patient in whom fascia lata was used, a woman of 43 years, died of chronic myocarditis a fortnight after the operation.

The results of these arthroplastic operations are shown in table



Fig. 1. Arthritis deformans of the hip in a 24 year old man, following epiphysiolsis of the femoral head. Note reduction in height of joint space, the evidence of sclerosis, and the osteophytes.



Fig. 2. Same case as in figure 1. A control roentgenogram taken 7 years and 9 months after a fasci-lata arthroplasty.



Fig. 3. Roentgenogram taken 1 year and 9 months after a vitallium-mold arthroplasty. Note the large, lip-shaped osseous outgrowths at the upper acetabular rim and the top of the greater trochanter, separated by a narrow space. There is a thin line of fresh deposit at the lower margin of the mold.



Fig. 4. Section from the tissue covering the femoral head in a patient in whom a vitallium mold had been in position for 24 months. Firm connective tissue, here and there showing small vessels running to the surface.



Fig. 5. Roentgenogram of a hip taken 2 months after a vitallium-mold arthroplasty.



Fig. 6. Same case as in figure 5, 23 months after the operation. The stump of the neck and head has been pressed deeper into the socket and the greater trochanter has moved closer to the pelvis. Note the large, newly-formed outgrowths from the acetabular rim and the greater trochanter.

1. (The patient who died is not included in the table.) The following principles were applied when judging the effect of the operations.

A good result = slight to no pain, a slight reduction in the flexing and abducting power of the hip, and over 40 degrees of motion in flexion.

A fair result = slight pain, moderate muscular insufficiency, and a maximum of 35—40 degrees of motion in flexion.

A poor result = severe lasting pain or greatly restricted movement, or both combined.

The upper age limit for arthroplastic procedures has been set by many observers at 50—55 years. The results achieved in the different age groups have been assembled in table 2:

Looking first at table 1, it will be seen that the arthroplasties with a fascia lata were more successful than those carried out with vitallium molds, since it was only after the former type of operation that a good end-result was achieved. Even if we place the cases in which the result was fair among the acceptable end-results, this predominance is still apparent, seeing that with the former type of operation two-thirds of the cases could be included while with the latter procedure the proportion was only one-third. The final result, 7 satisfactory cases out of 15 operated upon ($46\frac{2}{3}$ per cent), does not constitute a particularly favourable indication for the employment of arthroplasty in arthritis deformans of the hip. If we consider only the cases in which there was a satisfactory end-result, the proportion is 2 out of 15 operated upon ($13\frac{1}{3}$ per cent), a figure even less encouraging than the other.

Table 1.

*Results of arthroplasties in a series of cases
of arthritis deformans of the hip.*

Result	Operative method		Total
	Fascia-lata arthroplasty	Vitallium-mold arthroplasty	
Good	2	0	2
Fair	2	3	5
Poor	2	6	8
	6	9	15

In the group of patients treated by fascia-lata arthroplasty, the cases of most interest are those in which the end-results were good and poor respectively. The hospital records in respect of the two patients with good end-results were briefly as follows:

1 (1446/36). A farm hand aged 24 years. Four years before the arthroplasty he had been treated at the hospital in his home town for epiphysiolysis in the femoral head on the right side, his hip having been in plaster-of-Paris for 2 months. Six months before the arthroplasty, a "lengthening operation" was performed at the same hospital. He had been unfit for work for the past half year (fig. 1). On May 29, 1936, a fascia-lata arthroplasty. *Re-examination* on Mar. 7, 1944, 7 years and 9 months after the operation. He had undergone a fresh course of training and was now working successfully as a tailor. He experienced slight discomfort after much exertion, such as walking five kilometers, or bicycling a long distance. *Objective examination*: Functional and actual shortening of 5 cm. in the right leg. Considerable atrophy of the thigh. Muscular power in the leg good. Trendelenburg's test negative on both sides. Hip joint motion: flexion 80°, extension —5°, abduction 15°, adduction 5°, inward rotation 0°, outward rotation 20°. *Roentgen examination* (KNUTSSON): Articular surfaces still very uneven. The joint space had narrowed a little and the articular surfaces had become more sclerotic since the previous examination (fig. 2).

2 (2365/37). (This was one of the patients who did not come for a re-examination. She reported on her condition by letter.) A 30 year old woman, a boarding-house keeper. She had sustained an injury to the hip 5 years previously. Since then the hip had gradually deteriorated despite physical therapy and drilling by the GRABER-DUVERNAY method. The preoperative roentgen examination (KNUTSSON) revealed the following features. Advanced deforming and destructive arthritis with disintegration of the cartilage, osseous deposits, and subluxation. The adjoining parts of the skeleton showed rarefaction and the outlines were unclear. Aug. 4, 1937, a fascia-lata arthroplasty. Last examination Sept. 6, 1938. Flexion and abduction through a range of a little over 90°, and 25°, respectively, and very slightly restricted rotation. Power of active abduction weak.

In a letter dated Mar. 14, 1944, 6 years and 8 months after the operation, the patient reported that she felt completely well, that she could walk and run without pain, went hiking in the mountains, and ran her boarding-house almost unaided.

In both the cases in which the end-result was poor, severe lasting pain was reported at the re-examination 6 years and 2 months, and 5 years and 5 months, respectively, after the operation. In the former, greatly restricted motion and a positive Trendelenburg test were established, while in the other case the mobility was good, with a range of 95 degrees of flexion, but the

muscular power of the thigh was greatly reduced and the Trendelenburg test was positive. Both these patients were advised at the re-examination to undergo an arthrodesis. Finally, of the 2 cases in which the result was fair, one is undergoing physical therapy, 1 year and 9 months after the operation, because of stiffness which rapidly develops when the treatment is discontinued, and the patient has not yet returned to work. The last case, that of a 40 year old farm hand with advanced bi-articular arthritis deformans of the hip, did not present himself for a re-examination. On this patient, a corrective subtrochanteric osteotomy had been performed on the one hip and a fascia-lata arthroplasty on the other. At the last examination, 13 months after the operation, he had 40 degrees of joint motion and walked with two canes. He was advised to change his occupation as there was no likelihood of his being able to go back to his old work.

Of the 6 cases in which arthroplasty with a vitallium mold had given poor results, 3 still had pains when re-examined and 3 a considerable degree of stiffness and only 10° — 20° of motion in flexion. In 5 of the cases osseous outgrowths of varying extent had been deposited at the margin of the acetabulum and the greater trochanter or at the rim of the mold. In 3 instances the osteophytes at the acetabular rim and the top of the greater trochanter were so pronounced that the roentgenogram gave the impression of a complete bridge of bone (fig. 3). This feature was not observed in any case treated by fascia-lata arthroplasty, and it would therefore seem as if the implanted foreign-body material might not have been completely free from irritating properties. In the first mold arthroplasties performed at this Clinic the vitallium molds used were imported from the United States of America. When postal communications were cut off in consequence of the War the supply of molds was not sufficient to cope with the needs of the later patients. Molds manufactured in Sweden were therefore used instead, and it is possible that owing to the shortage of raw materials there may have been deficiencies in the alloying process. This may be the explanation of the osseous outgrowths. It should be stressed, however, that these osteophytes were observed in the first 3 cases operated upon; in 2 instances, certainly, they were only very small, but in one they were extensive.

One of the patients who had good movement in the hip following the intervention was left with discomfort in the form of

intense pain on weight-bearing. As it was thought that the trouble might be due to the mold, this was excised, 24 months after being implanted. The operation is too recent, however, to justify a statement as to the effect. This measure was based on an assumption similar to that held originally by SMITH-PETERSEN, a theory which he later abandoned when he came to the conclusion that the vitallium mold had no deleterious effect on the adjacent tissue and that it could thus be left in position without ill-effects. He has described the pathologico-anatomic findings in connection with tissue excised from the femoral head in two patients. In the first patient, who had had a glass mold in place for 21 months, it was found "that the newly-formed articular surfaces consisted mainly of fibrocartilage which in some areas approximated hyaline cartilage in character". In the other patient, in whom the mold had been in position for 25 months, the specimen from the femoral head showed "highly developed hyaline cartilage". In our case, we took a piece of the tissue covering the femoral head at a spot from which it was known that the old cartilage had been removed. Macroscopically, the specimen consisted of a smooth, yellow, fairly soft tissue in no way approximating cartilage in character.

A histologic examination, carried out by Dr. LARS SANTESSON at the Department of Radiologic Pathology of Karolinska Sjukhuset, Stockholm, yielded the following information: "Cut sections showed that the specimen was made up of adipose tissue, streaks of diagonally striated musculature, and firm sclerotic connective tissue resembling on the whole tendon tissue, in which the cellular element was fairly slight and which was arranged in large bundles having in places a gyrate appearance. In this firm connective tissue there were a number of small blood vessels, some of them distended.

One of the surfaces of the piece of tissue was fairly smooth. In places adjoining this surface there was a thin layer of loose connective tissue which was fairly rich in small vessels and more cellular than the firm sclerotic connective tissue deeper down. A few multinuclear giant cells were observed in this layer, which in some respects had a structure resembling synovial membrane.

In the firm connective tissue deeper down, there was a small focus of cartilaginous tissue with a central zone of ossification (fig. 4)".

Contributing to the discussion at the Orthopedic Congress at

Lund in 1941, ORELL reported that he had excised the mold in one of his patients because of severe, persistent pain. The pains then diminished in intensity and the joint motion was increased.

In his article of 1939, SMITH-PETERSEN stated that in no case after a vitallium-mold arthroplasty had he observed progressive necrosis in the stump of the head or in the neck. In one of our cases, however, this condition must have existed, as may be seen from figures 5 and 6. These pictures show how the neck stump had sunk deeper into the mold during the 23 months elapsing between the two roentgen examinations. The reason for this is not clear. Possibly it was due to the fact that the portion of bone removed was too large.

More striking postoperative malpositions were present in 5 cases. Two of these displayed an abduction contracture of 15 degrees with the resulting functional lengthening of 3 and 5 cm. respectively, while in 3 instances there were adduction contractures of 10, 15, and 15 degrees with the accompanying functional shortening of $5\frac{1}{2}$, 4, and 6 cm. respectively.

Table 2.

*Results in different age groups of arthroplasty
in arthritis deformans of the hip.*

A g e (years)	R e s u l t s			Deaths
	Good	Fair	Poor	
15—20	—	—	2	—
21—30	2	1	2	—
31—40	—	2	1	—
41—50	—	1	2	1
51—60	—	1	—	—
Over 60	—	—	1	—
	2	5	8	1

As may be seen from table 2, the best results were achieved in the patients whose ages ranged between 21 and 30 years. That the age is not of vital significance for the result, however, will be seen from the fact that in the same age group the results were poor in 2 instances, and likewise that they were poor in 2 patients in the 15—20 year old group. Besides the age, the duration of the process and the secondary lesions subsequently developing in the joint capsule, the ligaments, and adjoining parts also play a big

part; above all, the extent of the recovery is influenced by the patient's psychic reaction both to the actual operation and to the painful after-treatment.

To conclude, there are the functional results to be considered. For this purpose, the patients have been classified into three groups, viz. those able to work, those partially incapacitated, and those unfit for work, and the results in the different groups are shown in table 3. In only 8 out of 15 cases in which the result could be judged have the patients been able to return to their work without hindrance. It should be noted, however, that among these 8 patients one was left with pains as severe as those present before the operation and was advised, when she was re-examined, to undergo an arthrodesis, and another patient, while he had no pain, had greatly restricted hip motion and flexion and rotation through a range of only 10°.

Table 3.

Functional results of different forms of arthroplasty in arthritis deformans of the hip.

Operative method	Functional result		
	Patients able to work	Patients partially incapacitated	Patients unfit for work
Fascia-lata arthroplasty	13	—	23
Vitallium-mold arthroplasty.	25	2	2
	8	2	5

The following conclusions may be drawn from these observations.

1. Arthroplasty for arthritis deformans of the hip only gave satisfactory end-results in a small percentage of cases.

2. An operation with a fascia lata covering gave better results than the vitallium mold method.

3. Arthroplasty ought to be used only in, firstly, bi-articular arthritis deformans, in which case it should be regarded as a last

¹ One patient, previously a farm hand, had changed his occupation to that of a tailor.

² One patient had severe bi-articular arthritis deformans of the hip.

³ One patient has changed his occupation.

⁴ One patient had severe bi-articular arthritis deformans of the hip, and had to use an invalid's chair.

resort, and secondly, in the mono-articular cases, if the patient is absolutely dependent on a movable joint for the continuance of his work and if he cannot undergo training for another trade for which a stiff joint would be adequate.

4. Good end-results were not obtained from arthroplasty, in arthritis deformans of the hip, after the age of 30 years, and after 55 years of age the result was not even fair.

5. Arthroplasty to relieve arthritis deformans of the hip ought never to be performed on individuals with a strenuous occupation, nor on those with weak muscles and little energy and not much strength to withstand the strain of the postoperative treatment.

Summary.

The author describes the results of 16 arthroplasties in arthritis deformans of the hip. In 7 cases the operation was performed by the fascia-lata method and in 9 cases with a vitallium mold. The results were good in 2 instances, fair in 5, and poor in 8. Eight of the patients have returned to their work.

The experiences may be summarized as follows: In arthritis deformans of the hip, the chances of a successful end-result from arthroplasty are small. Fascia lata rather than vitallium molds should be used.

Satisfactory results were not achieved in patients over 30 years of age, nor in persons with strenuous occupations or individuals with weak muscles and low vitality.

Zusammenfassung.

Verf. berichtet über die Ergebnisse von 16 Arthroplastiken bei Arthritis deformans coxae. 7 mal wurde die Plastik mit Fascia lata vorgenommen, 9 mal mit Vitallium cup. Die erreichten Erfolge waren in 2 Fällen gut, in 5 mittelmässig und in 8 schlecht. 8 der Kranken konnten ihre Arbeit wieder aufnehmen.

Die gemachten Erfahrungen lassen sich folgendermassen zusammenfassen: Bei Arthritis deformans coxae liegen nur geringe Aussichten auf guten endgültigen Erfolg einer Arthroplastik vor. Es ist Fascia lata statt Vitallium cup. zu verwenden. Gute Endergebnisse wurden im Alter von über 30 Jahren nicht erzielt, ferner auch nicht bei Körperarbeitern oder muskelschwachen, energielosen Personen.

Résumé.

L'auteur communique les résultats de 16 arthroplasties dirigées contre des arthrites déformantes de la hanche. Dans 7 cas on s'est servi de fascia lata, et dans 9 d'une cupule de vitallium. Les résultats obtenus ont été deux fois bons, cinq fois médiocres et huit fois mauvais. Huit des opérés ont pu reprendre leur travail.

Les expériences faites peuvent être résumées comme suit: dans l'arthrite déformante de la hanche il n'y a que de faibles chances d'arriver à un bon résultat final par l'arthroplastie; le fascia lata doit être employé de préférence à la cupule de vitallium.

On n'a pas obtenu de bons résultats lointains chez les sujets de plus de 30 ans, pas plus que chez les travailleurs manuels ou les individus peu énergiques et à la musculature faiblement développée.

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Atypical Trigeminal Neuralgia Localized to the Ophthalmic Division and its Surgical Treatment.

By

LARS PREBER.

Facial neuralgias are not uncommon disorders. With regard to distribution, character and etiology of the pain they belong to a very heterogeneous group of regional and painful conditions which are still rather obscure and difficult to differentiate. One of these, however, is characterized by a syndrome of pains that has been known for a long time and of which detailed descriptions were published very early already. Many names were given to this form of neuralgia, viz. true, typical or malign trigeminal neuralgia, tic douloureux, trifacial neuralgia and major neuralgia. This severe chronic disease which is also known under the name of trigeminal neuralgia, chiefly affects elderly individuals. It is characterized by violent pains of short duration setting in spontaneously or is brought on by the slightest irritation of the sensory perception of the hyperaesthetical areas "trigger zones" within the distribution of one of the three peripheral divisions of the 5th cerebral nerve. Only a few symptomatic forms are known and with regard to the etiology of idiopathic trigeminal neuralgia there only exist certain hypotheses, experiments as well as pathologic-anatomical examination having failed to furnish definite evidence.

With the introduction of successful surgical method of treatment of trigeminal neuralgia, literature abounded with contributions discussing these methods and inciting to a closer study and investigation of the nature of the rest of the numerous facial neuralgias. All attempts, however, to throw some light on this

baffling disease have so far been fruitless, and the underlying causes as well as the treatment of the condition are topics of much controversy. The attempt was made to classify non-paroxysmal facial neuralgias on the basis of symptomatic factors. Owing to numerous circumstances, this encountered great difficulty, and the variety of painful conditions termed atypical trigeminal neuralgias, could not be classified at all. Under this in many respects misleading heading the majority of a variety of pains have been discussed which, with regard to symptoms and origin, are doubtlessly in no relation to one another and of which several, most likely, are not even of neuralgic nature. Atypical trigeminal neuralgias, however, have certain characteristic symptoms in common which clearly differentiate them from the typical form. There is absence of hyperaesthesia, the pain is not of paroxysmal nature, it is experienced in the form of a persistent, deep-situated, dull and boring pain, which the patient compares with toothache. The intensity of the pain varies and does not only affect the distribution of one of the trigeminal divisions, but it is apt to spread into the adjacent areas. In certain cases facial pains of this type are most likely due to functional disturbances of the nervous system, and if patients give a history of appreciating neuralgia like a pressure sensation, the suspicion is frequently justified that the condition may have a psychogenic basis. In such instances the complaint should not be interpreted as a sensation of pain, but as a feeling of discomfort, a condition that not infrequently is one of the first symptoms of presenile melancholia or of another form of psychosis. The majority of so-called atypical trigeminal neuralgias, however, most likely have an organic basis, but as their symptomatic picture differs widely from that of true trigeminal neuralgia, one is led to believe that their pathogenesis most likely differs too. Experience has borne out the fact that cases of atypical trigeminal neuralgia are completely refractory to surgical interventions aiming at the Gasserian ganglion and at the trigeminal root, an operation with which excellent results are obtained in paroxysmal facial neuralgias.

StjÖquist's *fiber* analysis revealed that part of the pathways of the trigeminal nerve within the medulla oblongata, is, practically without any exception, supplied with pain and temperature conducting fibres which are thus completely separated from the tactile fibres, and confined within the mesencephalic region. On the basis of these findings this author elaborated for the symp-

tomatic treatment of trigeminal neuralgia a new method of operation in which division of the *tractus spinalis nervi trigemini* is performed. This operation termed tractotomy seems to be in a large number of cases of paroxysmal neuralgia not only equally effective as division of the sensory root of the trigeminal nerve, but, in certain respects, superior to this surgical intervention. One of the advantages of tractotomy is that, contrary to the effect produced by section of the root which provokes a complete anaesthesia of the trigeminal distribution, Sjöquist's method of operation affords a dissociated anaesthesia which causes complete analgesia and thermal anaesthesia whereas sensibility to touch is maintained. In cases of atypical trigeminal neuralgia tractotomy was ineffective, and the results obtained with this method of treatment do not seem to be superior to those obtained with section of the sensitive trigeminal root. This surgical intervention may completely stop the paroxysmal pain, but it does not influence the persistent boring pain.

The part which the sympathetic system plays in trigeminal neuralgia and especially in the atypical forms, is a very much discussed problem. According to PEET, the sympathetic system accounts for various cases of atypical trigeminal neuralgia and in his opinion this condition is due to vasomotoric spasms. The majority of the neurosurgeons, however, advanced the view that surgical interventions aiming at the cervical sympathicus were ineffective in the mentioned painful conditions. FRAZIER reported that of 10 cases of atypical trigeminal neuralgia treated by extirpation of the superior and median cervical ganglion and by periarterial sympathetomy of the internal carotid artery, only 1 case showed amelioration.

PEET also reported discouraging results obtained with the operation on the sympathetic system in the presence of facial neuralgia and he cited cases in which the pains were even worse subsequent to the surgical intervention.

Occasionally, cases of atypical facial neuralgia were observed in which the pain was confined to a trigeminal division without showing any tendency towards spreading to contiguous areas. GLASER analysed 143 cases of so-called atypical trigeminal neuralgia and found that in 14 cases the pain was strictly confined to a certain area, namely in 3 instances to the supra-orbital, in 3 to the maxillary and in 8 to the mandibular trigeminal distribution. PEET even classified the forms of trigeminal neuralgia in

which the pain was confined to a strictly delineated area under a certain group and believed that these conditions, owing to their strictly defined anatomical localization were due to some form of alteration in the pathways of the trigeminal nerve. There is no doubt that his hypothesis may hold good in spite of the fact that the pain will persist after section of the sensory root of the Gasserian ganglion. Pains of central origin may be referred to the peripheral trigeminal divisions in spite of their conductivity having been cut off. This assumption is based on the observation that in cases of paraesthetic atypical trigeminal neuralgia occurring subsequent to facial herpes zoster and in which, owing to various circumstances, the pain must be assumed to be due to some pathologic-anatomical alteration of the trigeminal nucleus, root section or tractotomy do not give relief from the continuous pain. The symptoms of certain atypical trigeminal neuralgias are very much like those manifested in neuralgia coming on subsequent to facial herpes zoster and which, as a rule, affect the ophthalmic division. These forms are likewise refractory not only to root section but also to tractotomy and therefore one is led to believe that they most likely originate in the nucleus.

Some authors (KUHLENKAMPF *et. al.*) contested the possibility of primary trigeminal neuralgia affecting the ophthalmic division and believed that this type of neuralgia, if it occurred at all, was very rare. Sooner or later the affection seems to spread to the 2nd and occasionally even to the 3rd division. HARRIS reported a case of paroxysmal pains localized to the 1st trigeminal division which continued for 9 years before the pain spread to the 2nd division. FRAZIER studied a material of 2,861 cases of trigeminal neuralgia and stated that in 7 per cent of these, the pain was confined to the 1st division. JEFFERSON whose studies covered a similar material reported a ratio of 2 per cent. Up to the year 1943, 632 individuals were treated at the Neurosurgical Clinique of the Serafimer Hospital, Stockholm, on the basis of the diagnosis trigeminal neuralgia, but only in three cases were the paroxysmal pains confined to the area supplied by the ophthalmic division. Two of the patients who manifested this uncommon localization of pain, were treated by root section and the third was subjected to tractotomy. In all cases surgical intervention had afforded complete relief from pain (postoperative observation time: 13, 12 and 4 years respectively).

Case Reports.

Case 1. (SH/1928.) Male, aged 50. *History.* The patient complained of typical trigeminal neuralgia of 8 years standing and localized to the 1st division, on the right side. The attacks occurred in close succession to one another and were strictly confined to the supra-orbital and frontal regions. On admission he presented somatically and neurologically nothing pathological. On Oct. 25, 1929 *first operation* (OLIVECRONA): Section of the supra-orbital nerve. This operation was ineffective. On Nov. 13, *second operation* (OLIVECRONA): subtotal division of the posterior root. Subsequent to this operation there was complete tactile and thermal anaesthesia as well as analgesia over the 1st and 2nd trigeminal divisions. The corneal reflex was absent. The jaw deviated to the right. *Result:* the second operation gave complete relief from pain. (Postoperative observation time: 13 years.) Facial sensibility was completely reestablished 6 years after the operation.

Case 2. (SH/1930.) Male, aged 47. *History.* This patient complained of shooting pains which had come on 5 years previous to admission and which was radiating from the inner corner of the left eye upwards to the forehead on the left side and which were associated with increased lacrimation. In 1924 section of the supra-orbital nerve was performed. A few years later the symptoms recurred and the attacks of pain were of the same nature as before the surgical intervention. The somatic and neurological examination on his admission did not reveal any pathological conditions. On March 1st 1930, *operation* (OLIVECRONA): subtotal division of the posterior root. Subsequent to the operation the patient was completely relieved from pain. (Postoperative observation time: 12 years). Facial sensibility was completely reestablished in 1938.

Case 3. (809/1938.) Female, aged 48. *History.* The patient complained of paroxysmal pains in the left side of the face localized to the 1st trigeminal distribution and which had persisted for 10 years. The pains commenced around the left eye and spread upwards to the forehead. They were brought on by the touch of pressure points with a strange localization, namely in the left wing of the nose and in the region behind the left ear. The attacks were followed by a disagreeable sensation of vibration in the area to which the pain was localized. Occasionally, the attacks of pain were associated with scintillation. The findings at the somatic and neurological examination were negative. *Operation on Nov. 2nd* (OLIVECRONA): Tractotomy. Subsequent to the operation there was dissociated anaesthesia including analgesia and thermal anaesthesia, but tactile sensibility was intact. During the first week following the operation he complained of diplopia (paresis of the left ocular nerve). For 6 months subsequent to the operation he was hoarse (paresis of the left vocal cord). *Result:* Since the operation he was free from all complaints. (Postoperative observation time: 4 years and 5 months).

It is a most remarkable fact that paroxysmal neuralgia affecting the 1st trigeminal division, should be so rare. According to ANTONI, these forms of neuralgia usually run a more favourable course than the corresponding painful conditions which affect other branches and the 3rd trigeminal division. With regard to neuralgias, the 1st division therefore occupies a particular place. FRAZIER, on the basis of his studies of the morphology of the Gasserian ganglion and of the sensory root, explained this by the fact that there seems to exist a close phylogenetic and embryonal relationship between the 2nd and 3rd trigeminal divisions whereas the 1st division is not related to them and occupies a place apart. The recognition that the opthalmic nerve hardly ever was affected, profoundly modified the surgical treatment of trigeminal neuralgia. When performing division of the sensory trigeminal root, the opthalmic division may therefore be spared without causing any discomforts to the patient, and postoperative complications in the form of neuroparalytic keratitis which occasionally is a sequel of total section of the root, may thus be prevented. In the presence of paroxysmal neuralgia localized to the 1st trigeminal division, tractotomy is superior to division of the root, as it does not incur any risk of keratitis although it causes anaesthesia of the cornea. No damage is done to the innervation of the tear glands and the drying up of the cornea is prevented, a process which apparently accounts for neuroparalytic keratitis occurring subsequent to division of the sensory root of the trigeminal nerve.

Contrary to paroxysmal neuralgia, atypical trigeminal neuralgia localized to the area supplied by the opthalmic division, is of more frequent occurrence, especially in the form of the so-called supraorbital neuralgia which is more or less always characterized by a continuous pain localized to the supra-orbital area and chiefly affecting one side of the face. As a rule, there is also tenderness to pressure above the level of exit in the supra-orbital incision. Otherwise, the findings at the neurological examination are negative and deficiency symptoms such as loss of sensibility, pareses of the like are absent. Before definitely establishing the diagnosis supra-orbital neuralgia, it is essential to ascertain that the pains do not mask a primary pathological condition. To this purpose the past history as well as the condition of the patient should be carefully studied. Severe pains in the 1st trigeminal division are characteristic symptoms of certain types of aneu-

rysm of the carotid artery which, as is known, compress the walls of the cavernous sinus to a more or less high degree and which cause a pressure on the Gasserian ganglion or on one or several of its branches. JEFFERSON classed the aneurysms of the carotid artery into 3 groups, namely according to the symptoms and depending on the site of the anomaly in the respective artery. His studies revealed that in the presence of "anterior cavernous syndrome" only the 1st trigeminal division was affected. There exist a rather large number of secondary frontal neuralgias which are due to pathological conditions in the frontal sinuses, in the eyes or in the nose. Inflammatory processes involving the peripheral fibres of the 1st trigeminal division as well as a new-growth localized to this tract, may bring on a severe pain in the forehead. Especially chronic inflammatory processes localized to the frontal and sphenoidal sinus, may cause frontal neuralgia, which even may exhibit paroxysmal character. Sometimes this pain may also be elicited by mechano-reflex causes due to certain pathological factors such as dysplasias of the walls of the nasal cavity, a deviation of the septum, a spina, a crista or the like which exercise a pressure on the nerve-endings of the mucous membrane of the nose. Among various diseases of the nose which are of practical significance and which may cause neuralgia localized to the ophthalmic nerve DUERTO reported stasis in the frontal sinuses, a condition which the Americans term "vacuum sinus" and which is caused by obstruction of the ductus nasofrontalis. This condition causes absorption of the air enclosed in the frontal sinus, a process which in its turn gives rise to under-pressure and venous stasis in this cavity. If there is presence of the otitic complication apicitis, the patient manifests a troublesome, homolateral, neuralgic headache predominantly felt at night and mostly confined to the 1st trigeminal distribution. It appears strange that neuralgia which most likely is elicited by an irritation of the dura around the Gasserian ganglion should, in most cases, only affect the 1st trigeminal division. The above discussed localization of the pain observed in the presence of apicitis, a condition frequently associated with paresis of the 6th cranial nerve, may perhaps be explained on the basis of the assumption that there might exist some sensory connections between the 6th cranial nerve and the ophthalmic nerve at the level of their entrance into the orbit. Some diseases of the eyes, viz. iridocyclitis bring on neuralgic pains around the eye which not

only radiate upwards to the forehead, but also downwards to the cheek and the teeth ("orbito-facial pains"). The diagnosis of the condition referred to above, offers hardly any difficulty because, although frontal neuralgia is the predominant symptom, it is not the only one.

If the primary pathological causative agent is removed, f. i. by operation on an accessory sinus, it may happen, especially if the disease in question has been of long standing, that the neuralgia will persist unchanged. Based on these observations, GLASER termed certain cases of facial neuralgia "the syndrome of the many useless operations". The reason why surgical interventions are ineffective in relieving pain may be explained by the fact that a pathological process in the pathways of a certain nerve and which in some form also had affected the nerve itself, will cause a hypersensitiveness to various irritations to remain in these areas, even after the respective process has been subdued. Neuralgic headaches localized to the forehead and resembling supra-orbital neuralgia, may, in some cases, have a vasomotoric origin, but they may also indicate the presence of an intracranial tumor or of some malformation of a vessel. In severe or obscure cases of supra-orbital neuralgia, encephalographie or arteriographie examination will sometimes be indicated in addition to a specific ophtalmic and otologic examination and to roentgen examination. Frontal headaches may also be present in hypertension and lues. Headaches localized to the forehead and manifested in asthenopia, a condition not infrequently associated with tenderness to pressure above the supra-orbital nerve (Peters), may be mistaken for supra-orbital neuralgia, although this pain very rarely affects both sides. GREENWOOD reported that of 900 cases presenting refraction defects or disturbances of the muscles of the eyes, 480 manifested the above described type of pain as the only predominant symptom. In some cases of supra-orbital neuralgia certain migrainoid symptoms viz. vomiting and scintillation may be observed, and the condition is then incorrectly termed migrain, especially as the attacks of migrain occur very frequently on one side only and are localized to the 1st trigeminal division and because the pains are nearly always associated with tenderness to pressure above the level of exit of the supra-orbital nerve. Novocain injections into this nerve tract are ineffective in relieving the pain. A characteristic feature of the disease, however, is the fact that ergotamin nearly always has a soothing effect on the pain.

As a rule, supra-orbital neuralgia has a very favourable course, and conservative treatment, viz. massage, galvanisation a. s. o. generally offer relief from pain. The disease, however, responds rather uncertainly to therapeutical measures, especially as it occurs rather frequently in neurotic and hypersensitive individuals. In some cases therefore, it is a matter of great difficulty to determine whether the disease has a functional rather than an organic basis. Some severe cases of supra-orbital neuralgia may be refractory to conservative treatment and may run a chronic course. If this is the case, the condition most likely originates in the trigeminal nerve. This, however, is a mere hypothesis as the etiology of trigeminal neuralgia is still obscure. On account of practical reasons, especially with regard to the principles of treatment, the author considers it advisable to term the above discussed form of atypical neuralgia severe or malign supra-orbital neuralgia in contradistinction to the common supra-orbital neuralgia which is of benign and of acute character and which in a large number of cases should be viewed as psychalgia. Like all forms of supra-orbital neuralgia this type of pain is also localized to the entire or to a delineated area in the pathway of the ophthalmic nerve; it is of persistent, dull, boring and periodic character and is at times subjected to violent exacerbations. In the beginning the pain is comparatively slight and remits for periods of anything like up to one year. Gradually the periods of remission become shorter until the intervals between the attacks cease altogether and the pain develops continuous character. At this stage the disease is extremely distressing to the patient owing to the presence of a stubborn pain that troubles him incessantly during the day and frequently even at night. When the pain — which is usually felt on one side only — is at its worst, it may even spread to the temporal region, upwards to the parietal region and downwards to the occiput; it never spreads over the mid-line. Tenderness to pressure above the level of exit of the supra-orbital nerve is a rather infrequent symptom, and neurological as well as somatic examination do not reveal anything pathological. The disease appears to occur most frequently within the decade 30—40 and is not hereditary. Conservative treatment does not offer any relief and severe cases have for a long time already been treated surgically by peripheral alcohol injections or neurectomy. In cases of supra-orbital neuralgia, injections of some local anæsthetic agent, f. i. novocain, into the trunk of the nerve in the

incisura supraorbitalis, will relief from pain for the duration of the anaesthesia. This phenomenon may have some diagnostic value, as it may help towards establishing the correct diagnosis. Prolonged anaesthesia together with prolonged analgesia will be obtained if a solution of alcohol, f. i. a solution of 70 per cent is injected in the same manner into a nerve after the Schlösser-Bauman method. This process causes degeneration and resorption of those portions of the nerve which are important for its function. But when regeneration of the nerve is completed, neuralgia sets in anew, usually, within periods ranging from some months up to several years subsequent to the operation. Peripheral excision or section of the supra-orbital nerve is reported to entail the same conditions and KRAUSE who operated after this method on 19 patients which exhibited a very pronounced supra-orbital neuralgia stated that in the majority of the cases recurrence of the symptoms was observed already at the end of about 5 months subsequent to the surgical intervention. He further reported that of 134 cases of trigeminal neuralgia treated by peripheral neurectomy, no recurrence had occurred in 14 per cent of the cases. He did not state, however, how many lasting cures he had obtained among the 19 cases of supra-orbital neuralgia which he had treated by operation. ERTL-WIEN reported a method of operation on peripheral nerves in which a silver clamp was attached to the supra-orbital nerve instead of resection. The mild pressure exercised on the nerve by means of this clamp causes only certain nerve fibres to degenerate. Consequently the loss of sensibility is restricted, but is nevertheless sufficiently extensive to arrest the peripheral irritation which otherwise would elicit neuralgia. The sheath of Schwann, it is true, remains undamaged at the level where the clamp is fixed and therefore there is a possibility of regeneration. But according to ERTL-WIEN the clamp prevents all regeneration either by pressure or by chemical irritation. As to the effect of this method of operation in cases of supra-orbital neuralgia, no data are as yet available. Owing to the fact that this type of neuralgia affects the 1st trigeminal division, radical methods such as root section have so far been avoided and severe cases of supra-orbital neuralgia — owing to reasons referred to previously — have instead been subjected to tractotomy (SJÖQUIST). ROWBOTHAM described 3 cases of severe neuralgic pain localized to the forehead in which tractotomy after SJÖQUIST gave relief from pain. One of these cases may be discussed under

the heading severe supra-orbital neuralgia associated with some migrainoid symptoms. A study of the available literature referring to this field, did not furnish any data as to adequate methods of operation and their value. At the Neurosurgical Clinique of the Serafimer Hospital in Stockholm, 12 individuals exhibiting an exceptionally severe form of supra-orbital neuralgia, were treated by operation. In 6 cases peripheral resection of the supra-orbital nerve was performed and about $1\frac{1}{2}$ —1 cm of the nerve was extirpated; the 6 remaining cases were subjected to tractotomy after Sjöquist. This operation does not incur any considerable risk, but occasionally complications may occur in the form of transient cerebellar incoordination which is most likely due to lesions of the restiform body or to paresis of the recurrent nerve. At first Sjöquist suggested to make the incision in the medulla oblongata at a level corresponding to the caudal two thirds of the inferior olivary body. Experience proved, however, that it was much more difficult to obtain complete anaesthesia when proceeding in this manner than if incision was made in caudal direction around the olivary bodies because the tract is here deep-seated and the proximity of the intramedullar filaments of the nervus vagus increase the risk of paresis of the recurrent nerve. According to OLIVECRONA the most adequate procedure is the following: incision at a level across the inferior edge of the 4th ventricle or even somewhat more in caudal direction. This method practically eliminates all risks of paresis of the recurrent nerve.

Report of the Essential Data of the Case Histories.

Case 1. (809/1932.) Male, aged 46. *History.* In 1924 the patient fractured his nose. Since this accident his nose was deformed and he stated that he had been very nervous ever since (posttraumatic neurosis?). On admission to the hospital he gave a history of a periodic pain of 4 years standing. The pain was localized to the middle of the forehead and radiated to both sides and occasionally also backwards over the nape. He complained of a feeling of heaviness in his eyelids. In 1930 his nose was operated on (resection of the septum and removal of the turbinate bones). Subsequent to the operation there was an improvement, but soon the pains came back. Deviation of the nose was present. The somatic and neurologic findings were negative. *Operation* on April 4th, 1932 (OLIVECRONA): bilateral resection of the supra-orbital nerve. *Result.* For 3 years subsequent to the operation his condition was improved, but he was not symptomfree

At the end of this period his complaints recurred and were of the same nature as before the operation.

Case 2. (1663/1935.) Female, aged 43. *History.* Except from having always been very nervous, the patient had previously been fairly healthy. For 13 years she had experienced a boring pain ("toothache-like") above the eye. Sometimes this pain would shoot to the vertex. She had consulted more than 30 physicians in different countries without having obtained any relief from her complaints. In 1931 she was operated on in Norway and according to her statements, resection of the right and even a portion of the left supra-orbital nerve was performed. Since then she had been completely painfree on the right side, but on the left the pain had persisted unchanged. On admission to the hospital, the examination of the patient revealed that she was to a high degree neurotic and that she manifested symptoms of hysteria. Examination of the eye revealed a moderate hyperopia. Physical examination and roentgenograms of the skull did not reveal anything of interest. On June 22nd, 1935, *operation (OLIVECRONA):* extirpation of the left supra-orbital nerve. *Result:* Subsequent to the operation there was complete anaesthesia over the left supra-orbital distribution. The pains in this area had disappeared, but the neurasthenic troubles continued. 5 months after the operation she reported that the pains had come back and were as intensive as before.

Case 3. (628/1939.) Male, aged 59. *History.* The patient had been in good health until the onset of his complaints 3 years ago. Since then he suffered from a boring pain in the forehead on the right side, radiating to the nape and from attacks of pain setting in flash-like in the margo supra-orbitalis and spreading to the same area to which the boring pain was localized. Sometimes the attacks of pain were followed by nausea and scintillation. Gynergen therapy had not given any relief. The somatic and neurological findings were normal. Roentgenograms of the skull and encephalographic examination showed normal conditions. The diagnosis was considered uncertain in this case. The condition did not correspond to true trigeminal neuralgia nor to the common type of the so-called atypical trigeminal neuralgia. Some features of the picture suggested migraine, but at the patient's age migraine occurred very rarely. Besides gynergen therapy had been ineffective. One therefore was easily led to assume that the condition was due to an organic process in the proximity of the ganglion of the 1st division, eventually originating from the accessory sinuses or to aneurysms of the carotid artery or to some similar pathological alteration. No impairment of the sensibility could be demonstrated. Section of the root did not seem to be indicated owing to the fact that the 1st division was affected and therefore it was agreed to perform resection of the supra-orbital nerve and to await the results before subjecting the patient to a more radical operation in the form of tractotomy. On Sept. 20th, 1939, *operation (OLIVECRONA):* Resection of the right supra-orbital nerve. *Result:* Following the operation there was complete anaesthesia over the right supra-orbital distribution. There was no amelioration after the operation, except that the pains did not radiate

to the nape any longer. In 1940, the patient was subjected to a *second operation* in Denmark in which the sympathicus system was operated on, but also this surgical intervention was ineffective, nor did histamine treatment give any relief. The patient was advised treatment by tractotomy.

Case 4. (350/1941.) Male, aged 52. *History.* The patient had been in good health until the onset of a periodically continuous, boring pain above the right ear and which had persisted for 3 years. At the onset the pain was localized to the inner corner of the eye and to the nasal root, later on it shifted to the right supra-orbital margo and radiated upwards involving part of the forehead. In the beginning there were painfree intervals of up to 6 months duration and alternating with periods of pain ranging from a couple of days up to several weeks. Later on the periods of remission became shorter and the intensity of the pain increased. For a fortnight previous to admission, he continuously had experienced pains which even involved the eye-ball. On admission to the hospital there was a slight tenderness to pressure above the right supra-orbital nerve, further, a moderate hyperopia, but otherwise the patient's condition did not show anything abnormal. Roentgenograms of the skull and encephalographic findings were negative. On May 28th, 1941, *operation (OLIVECRONA):* resection of the right supra-orbital nerve; about 0.5 cm of the nerve were extirpated. *Result:* the operation gave complete relief from pain. (Postoperative observation time: 2 years and 4 months).

Case 5. (63/1942.) Male, aged 59. *History.* The patient had repeatedly been subjected to conservative treatment for frontal and maxillary sinusitis. His complaints commenced subsequent to a frontal sinusitis on the left side and had persisted after the inflammatory process had been subdued. For a year previous to admission to the hospital, he had experienced boring, at times, stabbing pains above the left eyebrow. These pains lasted for a few minutes and were brought on by coughing. Novocain injections were of no avail. Neurological and somatic examination did not reveal anything noteworthy. Roentgenograms of the skull and encephalographic examination did not reveal anything pathological. On May 28th, 1942, *operation (OLIVECRONA):* resection of the left supra-orbital nerve; 1 cm of the nerve was extirpated. *Result.* The operation gave complete relief from pain. (Postoperative observation time: 9 months).

Case 6. (40/1943.) Male, aged 62. *History.* The past history revealed hypertonia and various heart troubles as well as a surgical intervention for biliary calculi. He denied having had a venereal disease. Between the decade 25—35, he had suffered periodically from severe pains above the right eye. From then on, until about 10 days previous to admission, he had been comparatively painfree. Since then he had experienced an excruciating, boring pain which was localized to an area of the size of the palm of a hand, above the right eye. On admission he presented hypertonia to 190/100 and roentgenologically an enlargement of the heart + aortitis. Examination of the eyes revealed anisometropia + incipient catarrh of the left eye + hypertonic re-

tinopathy. Wasserman test was negative. Roentgenograms of the skull and encephalographic examination did not reveal anything noteworthy. On making the histamine test, it was found that the headaches were of a different character. On January 23rd, 1943 *operation* (OLIVECRONA): section of the supra-orbital nerve. 2 cm of the nerve were extirpated. *Result.* The operation gave relief from pain. (Observation time: 5 months). He died on Sept. 1st, 1943 of an unknown disease.

Case 7. (858/1939). Female, aged 31. *History.* The patient had previously suffered from headaches of migrainoid character. During the last 2 or 3 years before admission to the hospital, she had also been troubled by very intensive, continuous and boring pains localized to the forehead on the right side. She was neurasthenic. Somatic and neurological findings were negative. Roentgenograms of the skull and encephalographic examination showed normal conditions. On Dec. 18th, 1939, *operation* (OLIVECRONA): tractotomy. At the operation a large branch of the posterior inferior cerebral artery was found to run across the lateral surface of the medulla oblongata to which it adhered at a level from about the lower edge of the olivary body up to a level somewhat below the 4th ventricle. This vessel fillet may have provoked the irritation of the tract. *Result.* The operation was followed by complete analgesia over the entire trigeminal distribution. For 2 years and 9 months subsequent to the operation, the patient was painfree. At the end of this period the pains recurred and radiated then also to the nape and downwards over the neck and back. In Jan. 1943, she was readmitted to the hospital. She stated then that she began to recover sensibility in the spring of the year 1942. The examination revealed that the threshold of sensibility to touch and pain was lowered over a cuneiform area on the right side in the forehead close to the median-line. At the control examination in Nov. 1943, she showed on the forehead on the right side and even below the eye a few centimeters downwards over the cheek a lowered threshold of sensibility to pinpricks, but not to touch. The patient's statements about the localization of the pain were widely divergent and therefore the area over which sensibility was impaired, could not be recognized with certainty. The corneal reflexes were normal. Arteriographic examination of the right internal carotid artery revealed no pathological conditions. The diagnosis supra-orbital neuralgia was established. There was no indication for an additional surgical intervention, especially as the patient was found to be highly psychoneurotic. (In 1943, within a period covering the months of February and March, the patient was hospitalized at the Beckomberga Hospital in Stockholm on the basis of the diagnosis: psychopathia).

Case 8. (184/1938.) Male, aged 42. *History.* The patient had previously been in good health until the onset of an excruciating pain in the supra-orbital area on the left side and which had persisted for the past 3 years. The pain was of continuous character, coughing did not increase its intensity, it did not spread and was always confined to the same small zone above the right eyebrow. The neurological as well as the somatic findings were negative. Roentgenograms of the skull

showed that the skull was abundantly vascularized and that the upper portion of the sphenoid bone presented a pathological structure. Encephalographic examination revealed a slight displacement of the temporal horn at a level corresponding with the alterations of the bone, was visualized. No definite diagnosis could be established, but the encephalographic findings suggested the presence of a tumor localized to the posterior portion of the sphenoid bone. The roentgenological findings supported this assumption. On suspicion of the presence of a small meningioma presumably originating from the dura at the level of the Gasserian ganglion tract, an explorative operation was performed by detaching a flap above the left temporal region. No tumor was found, but the dura was abundantly vascularized at a level of the inferior part of the left temporal lobe. This abundant vascularization was the underlying cause of the alteration of the bone. On Oct. 30th, 1938, *operation* (OLIVECRONA): tractotomy. At the operation an arterial fillet was found, adhering to the medulla oblongata and causing an impression at a level below the olivary body. As it was necessary to perform tractotomy under general anaesthesia, it was difficult to obtain complete analgesia. The operation offered relief from pain for 4 months only, then the symptoms recurred. In the autumn of the year 1942, extirpation of the supra-orbital nerve was performed without any success. For the purpose of obtaining a complete analgesia, the patient was advised renewed tractotomy.

Case 9. (811/1939.) Male, aged 33. *History.* For 13 years he had been suffering from attacks of pain, localized to an area around the left eye. The duration of the attacks varied, they would persist for from half an hour to eight hours. The pains radiated to the forehead and upwards over the vertex. The patient could not state the causes which elicited the attacks. At times the attacks were associated with nausea and scintillation. Resection of the septum did not offer any improvement. Novocain injections and roentgen treatment had been ineffective. The patient was very nervous. The findings at the physical examination and in the roentgenograms of the skull were negative. On Dec. 5th, 1939, *operation* (OLIVECRONA): tractotomy. At the operation an arterial fillet was found which was a branch of the posterior inferior cerebral artery and which was adhering to the tractus. Subsequent to the operation there was complete analgesia on the left side over the 1st division as well as hypalgesia over the 2nd division and absence of the corneal reflex. The patient further presented a slight transient ataxia and on the contralateral side a diminished sensibility in the right hand, foot and lower part of the leg. *Result.* Subsequent to the operation he was symptomfree for about 1 year. At the end of that time the pains recurred, but were not as intensive as before the operation.

Case 10. (267/1941.) Male, aged 40. *History.* Apart from an inflammation of the maxillary sinus in 1938 and 1940, the patient had been in good health. For 6 years he had, at times, been suffering from a severe, continuous, boring pain above the right eye, and which radiated to the forehead and the temple and which was occasionally asso-

ciated with vomiting. He had consulted several physicians. The disease was assumed to be a migraine, but it was refractory to remedies. The physical as well as roentgen examination did not reveal anything abnormal. Peripheral novocain injections into the supra-orbital nerve previous to the operation arrested the pain spontaneously. On May 15th, 1941, *operation* (OLIVECRONA): tractotomy. At the operation several fillets of vessels were found lying in close proximity of the lateral side of the medulla oblongata. Nothing, however, was found which could have provoked pressure. On the following day the pains recurred. On May 25th, *second operation* (OLIVECRONA): tractotomy was performed anew. *Result*: subsequent to the second operation there was complete analgesia over the 1st division and the corneal reflex was absent on the homolateral side. The pains had subsided. (Postoperative observation time: 2 years and 4 months).

Case 11. (321/1940.) Female, aged 30. *History*. The patient had been in good health until the onset of a periodic, boring pain localized to the region above the right eyebrow and which did not radiate to the forehead, but, at times, to the right temporal region. The pain had troubled her for the past 8 years. In 1939 alcohol was injected peripherally into the right supra-orbital nerve. This operation relieved her from her troubles for 3 months. At the end of this period the pains recurred unchanged. Apart from tenderness above the level of exit of the right supra-orbital nerve, physical examination did not reveal anything abnormal. Roentgenographic and encephalographic findings were negative. On May 23rd, 1940, *operation* (OLIVECRONA): tractotomy. The operation was followed by complete analgesia over the 1st and 2nd divisions and by a moderately lowered threshold of sensibility to touch. The operation gave complete relief from pain. (Postoperative observation time: 3 years and 5 months).

Case 12. (172/1943.) Male, aged 34. *History*. The patient complained of a periodic, more or less violent, boring pain above the right eye of 7 years standing and which radiated into the right half of the head and to the nape. He stated that the pain had, at times, been excruciating and had troubled him continuously by day and by night. When the pain was at its worst, he scarcely dared to move and could only stoop with great caution. The patient was in a run down condition and on the verge of despair. Medication had afforded no relief. B-vitamin injections had been ineffective. The somatic and neurological findings were negative. In the roentgenograms of the skull a slight haziness in both frontal sinuses was visualized, The rest of the accessory sinuses of the nose contained air in normal quantities. Encephalographic examination revealed normal conditions. On March 1st, 1943, *operation* (OLIVECRONA): tractotomy. *Result*. Subsequent to the operation there was complete analgesia over the right half of the face. After the operation the patient was completely relieved from his troubles. (Postoperative observation time: 3 months).

Concerning the age of onset, the cases reported in this paper suggested that severe chronic supra-orbital neuralgia chiefly

affects individuals within the decade 30—40. With the exception of two patients who presented a symptom-complex suggesting also the coexistence of a pronounced neurosis and who exhibited a bilateral neuralgia, the pain was localized to one side of the head only. In one case the pain was localized to a small clearly defined area at a level in the proximity of the supra-orbital margo, whereas in the remainder of the cases, the pain was localized to the entire or to the major part of the area supplied by the 1st trigeminal division. Four patients reported that the pain would at times radiate from its central point in the forehead to the vertex and the nape, and one patient gave a history that the pain would periodically also spread to the homolateral frontal area. In three cases the symptom-complex included certain signs of migrainoid character, viz. seintillation, nausea and vomiting. Tenderness to pressure above the level of exit of the supra-orbital nerve, was present only in three cases. Two patients gave a history of an operation on the nose in the course of which the septum was resected. One of these, presented a deformity of the nose due to a trauma contracted 4 years previous to the onset of neuralgia and in the other case supra-orbital neuralgia had been a sequel of a frontal sinusitis and had continued after this process had been subdued. The case histories did not furnish any data which might help towards throwing some light on the etiology of the disease. The fact, however, should attract attention that the presenee of posttraumatic neurosis, hysteria and psychoneurosis was recognized coexisting with neuralgia. Various analgetic agents were ineffective and novocain injections administered to some patients, gave only transient relief from pain. Of the patients who were subjected to tractotomy, one had been given tentatively roentgen treatment before the operation which was unsuccessful. Peripheral alcohol injections given to one patient, had afforded relief for a period of three months only. In performing the two operations in the cases reported above, the routine technique with practically no modifications was followed. As a rule, the symptomatologic factors were not decisive for the choice of the method of operation and therefore the results of the operation, to a certain extent at least, may be considered suitable for evaluation and comparison, in spite of the very short postoperative observation time in some of the cases.

Case 8 should be excluded from the above survey of postoperative results as the technique of tractotomy in this case was

Postoperative Results of Peripheral Section of the Supra-Orbital Nerve.

Case No	Symp- tomfree	Ameliora- tion	No Effect	Recurrence after	Postoperative Obser- vation time
1		1		3 years	
2		1		5 months	
3			1		
4	1				2 years 4 months
5	1				9 months
6	1				5 months
	3	2	1		

Postoperative Results of Tractotomy.

Case No	Symp- tomfree	Ameliora- tion	No Effect	Recurrence after	Postoperative Obser- vation time
7	1			2 years 9 months	
8	1			4 months	
9	1			1 year	
10	1				2 years 4 months
11	1				3 years 5 months
12	1				3 months
	6				

deficient in so far as the patient's impaired condition called for general anaesthesia and no local anaesthesia could be given, and therefore the surgical intervention did not give complete anaesthesia. With regard to the cases 1, 2 and 7 in which neuralgia was associated with posttraumatic neurosis, hysteria and psychoneurosis, the postoperative results should also be viewed as very uncertain. If these cases are excluded, there remains a total of 8 cases which may be divided into the following groups:

Results subsequent to section of the supra-orbital nerve (4 cases) 3 symptomfree cases. (Postoperative observation time: 5 months, 9 months and 2 years and 4 months, one case was not cured.

Results subsequent to tractotomy (4 cases) 3 symptomfree cases. (Postoperative observation time: 3 months, 2 years and 4 months, 3 years and 5 months, respectively.

1 case symptomfree for the duration of 1 year followed by recurrence of the symptoms, which, however, were of milder character.

In the case of supra-orbital neuralgia whose symptom-complex was characterized by certain signs suggesting migraine, peripheral section of the peripheral nerve did not appear to give relief from pain (case 1), whereas tractotomy seemed to have a favourable effect (cases 9 and 10).

OLIVECRONA stated in an earlier paper, that compression of the spinal trigeminal tract may elicit chronic pain in the 1st trigeminal division and that these pains were of entirely different character than trigeminal neuralgia. On operating on case 8 an arterial fillet of the posterior inferior cerebral artery was found which adhered to the tractus and caused an impression below the olivary body. The operations on cases 7, 9 and 10 also revealed similar vascular fillets adhering to the lateral surface of the medulla prolongata, but not one of these fillets suggested to be the cause of pressure on that area. These operative findings may furnish a feasible explanation of the supra-orbital neuralgia exhibited by the 4 reported patients.

In case 8, the pain was exclusively localized to a small clearly defined zone above the eyebrow and the other 3 cases had, with regard to the localization of the pain, symptomatically no characteristic features in common. Two patients, however, presented a symptom-complex including certain signs of migrainoid character, viz. scintillation and vomiting (cases 9 and 10).

With regard to the treatment of such severe cases of supra-orbital neuralgia as described in the present paper and whose etiology is still obscure, there is no other surgical undertaking for palliative treatment to fall back upon than surgical nerve-block of the pain conducting nerve tract, Peripheral surgical intervention such as alcohol injections and nerve section appear to give only transient relief, but may be advisable in dubious cases, or if the patient's condition is not suitable for a more radical operation such as tractotomy after Sjöquist. In certain forms of atypical trigeminal neuralgia localized to the ophthalmic division, the postoperative results of tractotomy have been such as to suggest that this surgical intervention is effective and gives relief of prolonged duration, Owing to the fact that the postoperative observation time in some of the reported cases was too short and that so far only 6 cases of the comparatively rare condition termed supra-orbital neuralgia were treated by this operation, its value in the presence of this form of neuralgia cannot at present be definitely established. If, however, the symptom-complex

of supra-orbital neuralgia includes migrainoid signs, tractotomy should be the operation of choice, under all circumstances, especially as peripheral nerve section apparently does not even seem to offer a transient relief from pain in such cases.

Summary.

Paroxysmal neuralgia exclusively localized to the 1st trigeminal division is very uncommon and several authors even contested the occurrence of this form of trigeminal neuralgia. Among the 632 patients who were treated at the Neurosurgical Clinique of the Serafimer Hospital in Stockholm for typical trigeminal neuralgia, there were only 3 who presented pains confined to this area. The so-called atypical trigeminal neuralgia, however, which is localized to the opthalmic nerve, is not uncommon, and a very common condition is supra-orbital neuralgia which, as a rule, is benign. In some instances, however, the pains may develop a malign and periodic character and are then refractory to conservative treatment. This type of neuralgia most likely originates in the trigeminal nerve, and on account of practical reasons, especially with regard to principles of treatment, the author suggests to differentiate this condition from the usual and common supra-orbital neuralgia which may frequently be viewed as psychalgia, by terming it malign supra-orbital neuralgia. Before establishing the diagnosis, it is of major importance to ascertain that the pains are not secondary to sinusitis or some disease of the eyes or to processes within the cranium such as aneurysm of the carotid artery, or to any other primary disease. Cases of supraorbital neuralgia were tentatively treated with peripheral alcohol injections into the nerve or with resection of the nerve, a method which, as a rule, gave only temporary relief from pain. More radical methods of surgical treatment as f. i. total division of the sensory root of the trigeminal nerve were most unwillingly applied, because these interventions incur the risk of postoperative complications in the form of neuromyotonic keratitis. Since Sjöquist suggested tractotomy for surgical treatment, a method of operation is available which in many respects is superior to the above described methods, especially as it gives total analgesia within the entire trigeminal distribution and because, although the cornea is insensitive subsequent to the operation, there does

not seem to be any risk of keratitis which may be explained by the fact that no damage is done to the innervation of the tear glands.

At the Neurosurgical Clinique of the Serafimer Hospital 12 patients exhibiting malign supra-orbital neuralgia were subjected to surgical treatment. In 6 cases tractotomy was tentatively performed and the remaining cases were treated with peripheral section of the supra-orbital nerve. The choice of the method of operation was not exclusively based on the symptomatic factors and therefore the results are comparable. Tractotomy seems to be effective and to give freedom from pain for a longer period than peripheral section of the nerve. Owing to the fact that this method has so far been only tentatively performed on 6 individuals exhibiting this exceptionally severe form of supra-orbital neuralgia and because the follow-up periods with regard to end-results are still too short, the value of tractotomy in the presence of this type of neuralgia cannot at present be definitely established. In cases exhibiting certain migrainoid symptoms, tractotomy should under all circumstances be the operation of choice as peripheral section of the nerve does not even seem to give temporary freedom from pain in such cases.

Zusammenfassung.

Verf. berichtet über eine Form der sog. atypischen Trigeminusneuralgie, die in dem Ausbreitungsgebiet des ophthalmischen Astes sitzt und wahrscheinlich trigeminalen Ursprungs ist. Konservative Behandlung versagt, und seit langem haben bei schwerer Supraorbitalneuralgie periphere Alkoholinjektion und Neurektomie Verwendung gefunden, doch nur mit vorübergehender Schmerzlinderung als Folge. Von den radikaleren Eingriffen hat man alle die bei den paroxysmalen Gesichtsneuralgien mit so gutem Erfolg verwendeten, am Ganglion Gasseri oder der sensiblen Trigeminuswurzel angreifenden Operationen vermieden, und in letzter Zeit stattdessen intramedulläre Traktotomie nach Sjöquist versucht. Einer der Vorteile der letztgenannten Operation ist, dass keine Gefahr einer postoperativen Komplikation in Gestalt der Keratitis neuroparalytica vorzuliegen scheint. Beim Studium der zugänglichen Literatur waren keine Angaben über den Wert der verwendeten Operationsmethoden erhältlich. In der

Neurochirurgischen Klinik des Serafimerkrankenhauses waren 12 Patienten in Pflege, die wegen überaus schwerer Supraorbitalneuralgie chirurgischer Behandlung unterworfen wurden. In 6 Fällen wurde der Nervus supraorbitalis peripher durchtrennt und $\frac{1}{2}$ —1 cm des Nerven entfernt, in den übrigen Fällen kam die Traktotomie nach Sjöquist zur Ausführung. Die symptomatischen Faktoren sind bei der Wahl der Operationsmethode nicht massgebend gewesen, so dass die Operationsergebnisse in gewissem Masse verglichen und beurteilt werden können, wenn auch die Beobachtungszeit in gewissen Fällen zu kurz gewesen ist. Es scheint, dass die Traktotomie effektiver ist und dauernde Schmerzf়reiheit gibt, während die Neurektomie, wie die Alkoholinjektion, nur vorübergehende Schmerzf়reiheit gibt. Diese letzteren Operationen sind anzuraten in Fällen, wo die Diagnose unklar ist, oder der Zustand des Kranken keinen radikaleren Eingriff zulässt. Bei schwerer Supraorbitalneuralgie mit gewissen migränoiden Zügen gibt periphere Neurektomie nicht einmal vorübergehende Schmerzf়reiheit, so dass die Traktotomie vorzuziehen ist, da diese Operation hingegen auch bei solchen Formen von Neuralgie effektiv zu sein scheint.

Résumé.

L'auteur s'occupe d'une forme dite atypique de névralgie du trijumeau qui est localisée à la zone de distribution de la branche ophtalmique et est vraisemblablement d'origine trigémínée. Le traitement conservateur est inopérant: il y a longtemps qu'on a pratiqué les injections périphériques d'alcool et les neurectomies dans les névralgies sus-orbitaires graves, mais toujours avec un effet sédatif seulement temporaire.

Quant aux interventions plus radicales, on a évité d'appliquer à cette affection l'une ou l'autre des opérations qui donnent de si grands succès dans la névralgie faciale paroxystique et qui s'adressent au ganglion de Gasser ou à la racine sensitive du VII, mais ces derniers temps, à la place, on a essayé la tractotomie intramédullaire de Sjöquist. Un de ses avantages, c'est qu'avec elle il ne semble pas exister de risque de complications postopératoires sous la forme de kératite neuroparalytique. L'étude de la littérature disponible n'a pas pu renseigner sur la valeur des diverses méthodes opératoires employées. A la Clinique neuro-chirurgicale du Serafimerlasaret on a soigné 12 malades qui furent soumis à

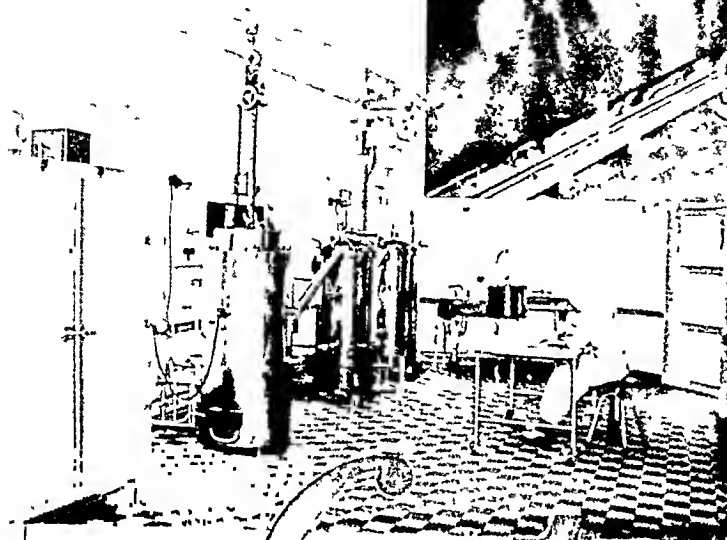
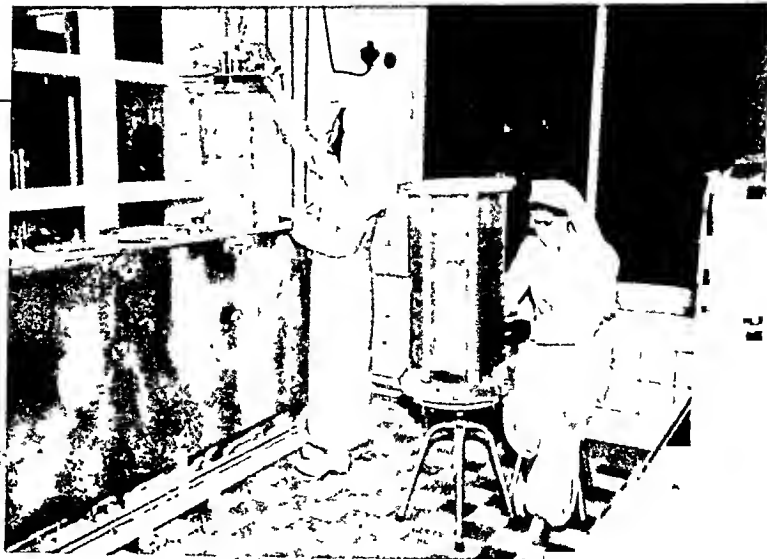
un traitement chirurgical à cause de la sévérité particulièrement grande de leur névralgie sus-orbitaire. Chez 6 d'entre eux on sectionna le nerf sus-orbitaire à sa partie distale et on en extirpa $\frac{1}{2}$ à 1 centimètre; chez les autres on exécuta la tractotomie de SJÖQUIST. Ce ne furent pas les symptômes cliniques qui dictèrent le choix de la méthode opératoire, de sorte que les résultats de l'intervention sont comparables entre eux et permettent de porter un jugement dans une certaine mesure, bien que le temps d'observation soit trop court pour plusieurs des cas. Il semble que la tractotomie soit plus efficace et donne un résultat durable, tandis que la neurectomie, comme aussi l'injection d'alcool, ne procure qu'une suppression passagère de la douleur. Ces derniers procédés peuvent être conseillés dans les cas où le diagnostic est douteux, ou bien lorsque l'état du malade ne permet pas le recours à des interventions plus radicales. Dans les névralgies sus-orbitaires de caractère grave accompagnées d'un certain nombre de symptômes migrainoïdes, la neurectomie périphérique ne donne pas même une sédation temporaire, de sorte que la tractotomie doit lui être préférée puisqu'elle semble efficace même dans ces formes-là.

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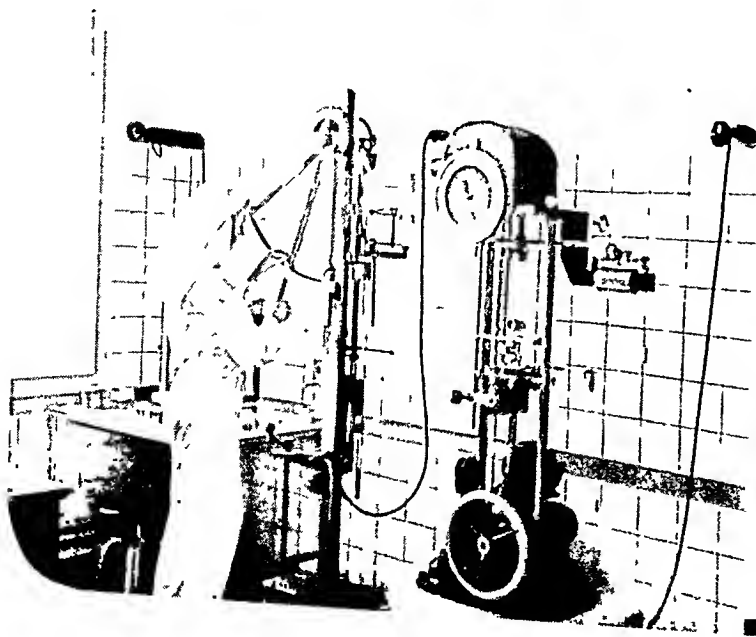
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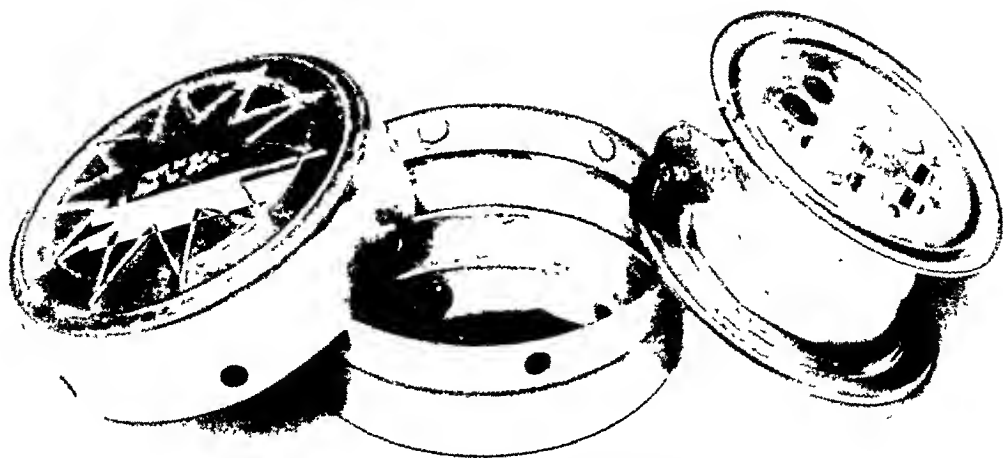
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ASTRA



Carlqvist - SVENSK TILLVERKNING





STERIL-CATGUT

ASTRA

Astra har upptagit tillverkning av catgut i härför specialbyggd fabrik. Astras steril-catgut steriliseras enligt fysikaliska metoder, således utan användning av kemikalier. Absolut sterilitet och överlägsen knythållfasthet garanteras (min. 16 kg/mm²). Catguten levereras i sjukhusförpackning på spolar à 50 meter i *ogarvat* eller *garvat* utförande. Astras catgut tillhandahålles i följande grovlekar :

N:o	3/0	2/0	0	1	2	3	4
mm min.	0,20	0,25	0,30	0,35	0,40	0,50	0,60
» max.	0,25	0,30	0,35	0,40	0,50	0,60	0,70
Motsv. diam. enl. tysk std.	0,20/0,25	0,26/0,31	0,31/0,36	0,36/0,42	0,42/0,50	0,50/0,58	0,58/0,68

Die Stellektomie auf lateralem, skalenovertebralem Wege.

Von

Dr. CHR. VAN GELDEREN.¹

Vorstand der I. chirurgischen Klinik des städtischen Krankenhauses
»Binnen-Gasthuis« Amsterdam.

Die Eingriffe am autonomen, besonders orthosympathischen Nervensystem beanspruchen in den letzten Jahrzehnten wachsendes Interesse, umso mehr als es sich gewissermassen um einen Strebpfeiler der funktionell-pathologisch begründeten operativen Chirurgie handelt. Dementsprechend wurden nicht nur oft funktionelle bzw. funktionell betonte Erkrankungen (Angina pectoris, essentieller Hypertonus, Megacolon, örtliche Durchblutungsstörungen) operativer Behandlung zugeführt, sondern es entstanden auch neue Operationen. Teilweise strebten diese den erwünschten anatomischen Effekt auf technisch verschiedene Weise an (sub- bzw. supradiaphragmatische Splanchnicusresektion nach ADSON bzw. PEET; Operation des N. praesacralis s. Plexus hypogastricus per laparotomiam oder auf sakralen Wege nach COTTE-LEARMONTH oder VAN GELDEREN), andernteils beabsichtigten sie den nämlichen funktionellen Erfolg durch andere, einfachere Eingriffe am autonomen Nervensystem zu erreichen: so hört man kaum noch von der operativen Resektion des gesamten Hals sympathicus, dagegen hat sich die Exstirpation des sog. Ganglion stellatum (neuerdings heisst es »stellare«), die Stellektomie durchgesetzt.

Neurochirurg, namentlich ausschliesslicher Neurochirurg braucht man meines Erachtens für eine erspriessliche operative Tätigkeit auf diesem Gebiete keineswegs zu sein, umso mehr als mancher Neu-

¹ Früher Privatdozent am Anatomischen Institut der hiesigen Universität.

roehirurg sich ganz vorwiegend im Schädelinnern und im Wirbelkanal heimisch fühlt. Der anatomisch gut vorgebildete Allgemeinchirurg, der in der Bauchhöhle und auch am Halse wohl viel besser bewandert sein dürfte, scheint mir zu Operationen am autonomen Nervensystem wenigstens gleich gut befähigt. Daraus erklärt sich dieser Beitrag eines, allerdings auch neurochirurgisch besonders ausgebildeten und nebenbei tätigen, Allgemeinchirurgen.

Wie gesagt erfreuen sich die Eingriffe am Ganglion stellatum, dem Konglomerat des Ganglion cervicale inferius und Ganglion thoracale primum des Grenzstranges steigender Beliebtheit und zunehmender Anwendung, nicht nur in der Bekämpfung etwaiger Durchblutungsschäden am Arm (und sonstiger trophischer Erkrankungen) sondern auch in der Behandlung viszeraler Leiden. Die zeitweilige — jedoch sofortige — Blockade des Ganglion stellatum mittels Novokaineinspritzung verfolgt entweder nur einen augenblicklichen therapeutischen Erfolg: die Kupierung eines stenokardischen Anfalls, oder dient der Indikationsstellung zur Exstirpation, indem sie zeitweilig den als Dauererfolg beabsichtigten Effekt einschätzen lässt. Hauptverwendung jedoch findet heutzutage die Exstirpation des Ganglions, hinter welcher die Vernichtung desselben durch Alkoholeinspritzung zurücktritt. Es sind wohl alle darüber einig dass die periarterielle Sympathektomie keineswegs dauerhaft wirkt, hauptsächlich dadurch dass es sich bei derselben nur um eine sehr unvollständige orthosympathische Entnervung handelt. Die Ramisektomie s. Ramisektion, soweit dieselbe noch in Betracht kommen könnte, wäre für die obere Extremität kaum zu verwirklichen bei Erhaltung der Ganglien an sich; sie gelangt auch sonst kaum noch zur Anwendung.

Während die sympathischen Ganglien der Lenden- (und Brust-)region angegangen und aufgefunden werden als Anschwellungen des Grenzstranges eignet sich ein entsprechendes Vorgehen wenig für das untere Hals- bzw. oberste Brustganglion. Der obere Brustgrenzstrang ist sowieso schwieriger zugänglich als die anzugehenden Ganglien (Ggl. stellatum), er kommt somit als Leitgebilde nicht in Betracht, wenn er auch sonst dazu sehr geeignet wäre. Der Halssympathicus dagegen ist zwar auf den prävertebralen Halsmuskeln ziemlich leicht zugänglich aber der Übergang desselben in das untere Halsganglion liegt ziemlich versteckt hinten unter der A. subclavia. Auch führt der Halssympathicus

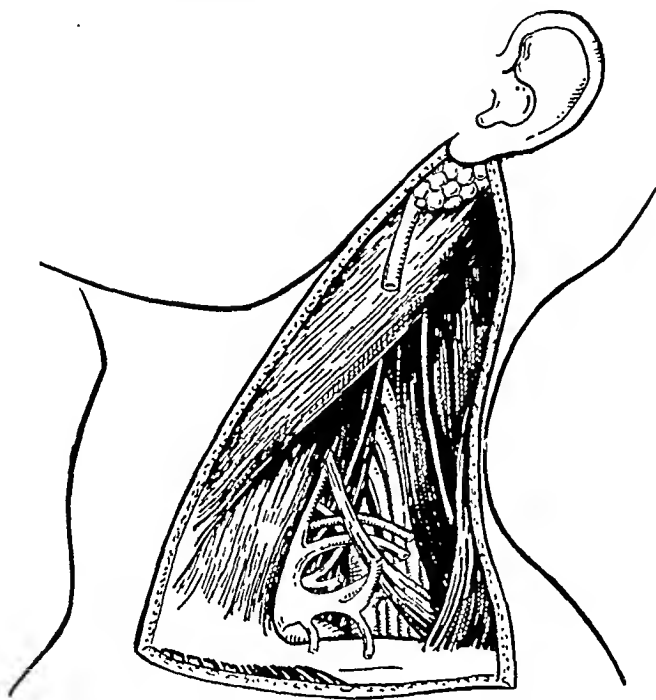


Abb. 1. Seitliche Halsgegend: oberflächliche Gebilde (Angulus venosus, N. phrenicus, D. thoracicus).

keineswegs geradlinig auf das untere Halsganglion, das mehr lateral liegt. Die Bestrebungen das Ggl. stellatum mittels des Halssympathicus zu erreichen hörten demzufolge auf sobald die Entfernung des Halssympathicus neben der Entfernung des Ggl. stellatum als nebensächlich erkannt wurde und in den Hintergrund trat. Heutzutage wird das Ggl. stellatum meist direkt, nicht indirekt auf dem Wege des sympathischen Hals-bruststranges aufgesucht, indem man sich anderer Leitgebilde bedient.

Das Ggl. cervicale inferius liegt in dem Spalt zwischen M. longus colli und M. scalenus anterior in dem Trigonum (richtiger Spatium) scalenovertbrale, dem Ursprung der A. vertebralis aus der A. subclavia recht nahe. Es liegt zwischen dem Querfortsatz des siebten Halswirbels und der ersten Rippe etwa 1 cm. lateral vom costovertebralen Gelenk, somit vor dem Rippenköpfchen. Ist das untere Halsganglion mit dem ersten Brustganglion verschmolzen, liegt also ein richtiges Ganglion stellatum vor, so erstreckt sich die Ganglienmassa auch noch vor dem Hals der ersten Rippe herunter. Sollte das zweite Brustganglion mit einbezogen sein, so reicht das auffällig grosse vereinigte Ganglion noch weiter

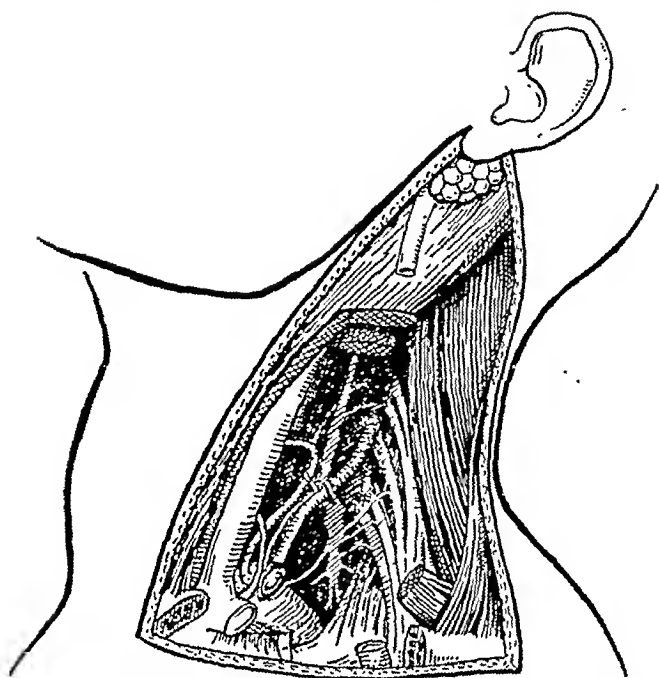


Abb. 2. Seitliche Halsgegend: tiefe Gebilde (D. thoracicus, A. thyroidea inf., A. vertebralis, Ggl. stellatum.)

kaudal, in den Brustkorb hinein. Regelmässig findet sich das Ggl. cervicale inferius (bzw. stellatum) in der Verlängerung des Brustgrenzstranges, als dessen oberstes Ganglion es sich sozusagen benimmt. Meist befindet es sich hinter oder lateral von der A. vertebralis, doch wechselt das gegenseitige Lageverhältnis ausserordentlich. Das Ggl. cervicale inferius erhält Rami communicantes von den Halsnerven (V), VI und VII. Ein richtiges Ggl. stellatum weist somit auch noch einen Ramus communicans vom N. thoracalis I auf. Mittels dieser Rr. communicantes hängt es also medial-unten an den kaudalen Wurzeln des Plexus brachialis. Die Verbindung mit dem oberen sonstigen Halssympathicus wird durch die sogenannte Ansa subclavia gebildet. Falls ein mittleres Halsganglion vorhanden ist, gehen aus demselben unten zwei Nervenbündel hervor, das vordere dünnere zieht vor der A. subclavia herunter, dann unter derselben nach hinten (dorsal) und steigt seitlich hinter der A. subclavia wieder zum Ggl. cervicale inferius heran. Das hintere dickere, auch kürzere Nervenbündel senkt sich von oben medial her. in das untere Halsganglion, bzw. Ggl. stellatum ein. Nur diesem hinteren

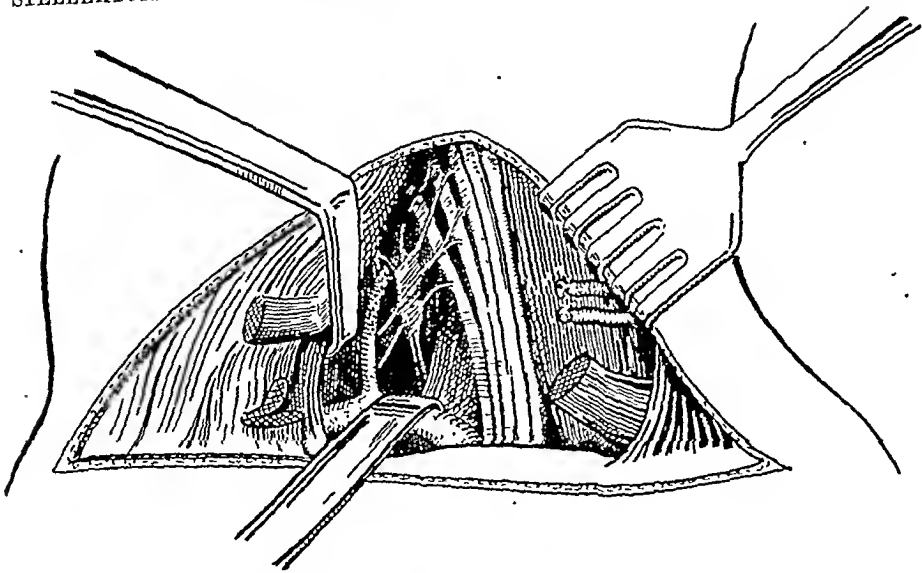


Abb. 3. Operationsskizze: Plexuswurzeln, A. vertebralis, Ggl. stellatum.

Bündel entlang wäre bei etwaiger Operation das Auffinden des erwünschten Ganglions vom Halssympathicus her möglich. Sollte das mittlere Halsganglion nicht ausgebildet sein so teilt sich der Halssympathicus unter der Kreuzung mit der A. thyroidea inferior (auch diese kann in einer sympathischen Nervenansa enthalten sein) in die beiden Schenkel der Ansa subclavia. Letztere verknüpft den mehr medial gelagerten Halssympathicus mit dem weiter lateral befindlichen Brustgrenzstrang, beide Schenkel der Ansa subclavia kreuzen die A. vertebralis schief an deren vorderer Seite, führen jedoch erst über sonstige sympathische Fasernetzchen in das weiter lateral befindliche untere Halsganglion, was sein Auffinden vom Halssympathicus her erschwert.

Im Schrifttum sind im grossen und ganzen zwei operative Wege zum Ganglion stellatum verzeichnet: der hintere und der vordere. Der hintere Operationsmodus erreicht das Ganglion vom Rücken her auf dem Wege eines paravertebralen hoch in den Hals (Nacken) hineinragenden Längsschnittes. Mittels Resektion des Halsteils der ersten Rippe etwa auch teilweise der Zweiten arbeitet man sich an das Ganglion heran; der Zugang ist nicht gerade geräumig, auch befinden sich die Stämme der benachbarten Spinalnerven im Wege. Diese Operationsweise welche auf Adson zurückgeht dürfte so ziemlich verlassen sein, sie ist wenig übersichtlich erinnert übrigens an die gleichfalls paraverte-

brale (supradiaphragmatische) Splanchnicus- und partielle Grenzstrangresektion PERRÉ's.

Vom vorderen Wege gibt es mehrere Varianten, die alle medial vom M. scalenus anterior arbeiten, also medial an dem Spatium scalenovertebrale vorbeigehen und bei denen das Ganglion gefunden wird, manchmal geleitet von der A. vertebralis (RINDER). Während LERICHE zwischen dem sternalen und klavikularen Kopf des M. sternocleidomastoideus hindurch ging, arbeitet RINDER an der medialen Seite des Kopfwunders vorbei. Andere bedienen sich des Zuganges seitlich vom M. sternocleidomastoideus doch medial vom M. scalenus anterior. Der Hautschnitt parallel dem Kopfwunder ist stark bevorzugt, ungeachtet der unschönen Narbe desselben. In der Einkerbung benachbarter Muskelränder sind, nicht das Wesentliche betreffende, Varianten begründet: stets führt der Weg in nächster Nähe links an der Endstrecke des Ductus thoracicus vorbei, auf beiden Seiten ist der N. phrenicus sehr nahe in dem Gebiete wo ersterer seine Vorderseite kreuzt, bzw. der Ductus lymphaticus dexter entsprechend verläuft. Der N. phrenicus senkt sich bekanntlich unten am medialen Rande des M. scalenus anterior, vor der A. subclavia in den Brustkorb hinein. Weniger wichtig erscheint dass der Truncus jugularis lymphaticus sich gleichfalls medial vor dem unteren Teil des vorderen Skalenusmuskels befindet. Die grundsätzliche Durchtrennung des M. scalenus anterior schafft zwar mehr Raum, gefährdet dafür links den Ductus thoracicus genau sowie die rein-vorderen Eingriffe am medialen Rande desselben Muskels vorbei. Fast stets wird bequemenhalber die A. thyroidea inferior zwischen Ligaturen durchtrennt oder sogar der Truncus thyrocervicalis geopfert. Man gelangt dann an die Vasa vertebralia, namentlich die Schlagader führt auf das Ganglion, dass derselben meist hinten-lateral anliegt. Der D. thoracicus bzw. der Ductus lymphaticus dexter der sehr variabel hoch im Bogen oder spitzwinklig in die Halsbasis hineinragt kreuzt die A. vertebralis an deren medialer Seite, liegt dann medial vom aufsteigenden Teil der A. thyroidea inferior und zieht schliesslich zwischen der V. vertebralis und der V. jugularis interna hindurch. Er kreuzt zuletzt noch die Ventralseite des N. phrenicus vor dem medialen — unteren Teil des M. scalenus anterior und senkt sich von lateral her in den sog. Angulus venosus ein. Das untere Halsganglion sowie das erste Brustganglion, falls nicht mit dem ersten verschmolzen, lässt es sich an ihm leicht emporziehen,

werden somit bei vorderen Eingriffen oft auf dem Gefässwege gefunden. Erst bei der Durchtrennung seiner Rami communicantes zur Exstirpation bekommt man die entsprechenden Spinalnerven (Plexuswurzeln) vielleicht zu Gesicht; darin ist etwas unnatürliches begründet dass dem allerdings kürzesten, rein-vorderen Operationswege anhaftet.

Es sind mehrere Umstände gewesen die mich vom vorderen Wege zur Stellektomie abgebracht haben. Der äussere Anlass jedoch rührt von Erfahrungen mit der anterolateralen (sog. vorderen) Halsrippenexstirpation her: dabei dringt man ziemlich unsehwer der Ventralseite des Brachialplexus entlang bis auf das Köpfchen der Halsrippe vor, nähert sich somit der Gegend des Ggl. stellatum sehr. Der anterolaterale Weg zum Ggl. stellatum an dem lateralen Rande des M. scalenus anterior vorbei und zwischen diesem und der Vorderfläche des Brachialplexus hindurch geht durch das Trigonum (Spatium) scalenovertbrale. Er wird zwei Grundsätzen gerecht: der Operatör bleibt dem Ductus thoracicus überall bzw. den andern grossen Lymphgefässen auch möglichst fern, hält sich dabei auch weit vom N. phrenicus und erreicht das Ganglion nebenbei auf dem natürlichsten = Nervenwege. Ausserdem genügt ein tiefer, dem Schlüsselbein paralleler und sehr naher, teilweiser Kragenschnitt, der eine fast unsichtbare Narbe hinterlässt.

Bei der skalenovertbralen, (antero-) lateralen Stellektomie schliesst sich dem Hautschnitt und der Spaltung des Platysmas die doppelte Unterbindung mit folgender Durchtrennung der V. jugularis externa sofort an. Der laterale Rand des Kopfwenders wird, so weit er den lateralen Rand des vorderen Skalenusmuskels verdecken sollte, eingekerbt und nach medial verzogen. Der laterale Skalenusrand wird unten, vor den getasteten Pulsationen der A. subclavia freigelegt und gleichfalls medialwärts verlagert. Das Interstitium zwischen den Mm. scalenus anterior und sternocleidomastoideus — mit den darin enthaltenen Gebilden — wird also gar nicht eröffnet. Es liegt nunmehr die ventrale Fläche des Plexus brachialis, das heisst seines unteren Teils vor. Der hintere Bauch des M. omohyoideus kann durchtrennt, nachher genäht werden. Damit auch die medial-aboralsten Plexusteile sich übersichtlich darstellen lassen wird die A. transversa colli, die den Plexus meist zwischen C. 6 und C. 7 durchsetzt, geopfert. Der Truncus costocervicalis wird durchtrennt oder, kaum bemerkt, verlagert. Manchmal erleichtert man sich den Zugang dadurch

dass zwei weitere oberflächliche, querverlaufende Gebilde, die *A. cervicalis superficialis* (oben) und bisweilen auch die *A. transversa scapulae* (unten), nach Unterbindung durchtrennt werden. Sich ventro-medial vom Brachialplexus vorfindende Muskelfasern eines *Scalenus minimus* (bzw. des *Lig. costo-pleuro-vertebrale*) werden von der ersten Rippe gelöst, aus dem Wege geschafft. So vergeht es auch etwaigen variationsweise hinter der Schlagader, bezw. unmittelbar vor dem Plexus befindlichen Fasern des *M. scalenus anterior*. Die *A. subclavia* lässt sich jetzt nach unten und vorn ziehen. Zur Freilegung der Pleurakuppel hat man nur noch die sog. Sibsonsehe, sie bedeckende Faszia an der ersten Rippe zu spalten. Stumpf drängt man die Pleura ab nach unten (medial), hält sie nunmehr unter einem Hakenspatel zurück. Ein entgegengesetzter Zug nach oben-lateral könnte den gegenüberliegenden Gebilden nur schaden: die Plexuswurzeln quetschen; doch liegt ein entsprechender Bedarf auch gar nicht vor.

Indem man mit dem Finger der ersten Rippe entlang geht, den *N. thoracalis I* dabei vor Druck schützt, lässt sich das Köpfchen der *I* Rippe leicht tasten, lassen sich die unteren Plexuswurzeln auch bis an die Wirbelsäule heran darstellen; das ist allerdings kaum nötig. Medial — unter denselben findet sich das Ganglion *cervicale inferius* vor dem Köpfchen/Hals der ersten Rippe, ein selbständiges Ggl. *thoracale I* liegt unter diesem Rippenhals, vor dem ersten Thoracalnerven. Beide, bzw. das vereinigte Ggl. *stellatum* hängen sozusagen mittels deren *Rami communicantes* an den Wurzeln des Plexus *brachialis*. Die *Vasa vertebralia* liegen meist an der medialen Seite¹ (der *Tr. costocervicalis-A. cervicalis profunda* an der Lateralen); noch weiter medial, auch jenseits der *A. thyroidea inferior*, ist (links) der *Ductus thoracicus* auch hier ausser Reichweite: er ist somit bei meinem Vorgehen auch tief in der Operationswunde nicht gefährdet. Der Exzision steht jetzt nichts mehr im Wege indem man allseitig die Nervenverbindungen, auch die nach medial-unten abgehenden Viszeraläste (*rr. cardiaci*), durchschneidet, gegebenenfalls mittels der unteren das selbständige oberste Brustganglion heraufholt. Auch das zweite Ganglion *thoracale* zu entfernen scheint mir, wie auch LERICHE nicht stets unbedingt nötig.

Man werfe mir nicht vor bei meinem (antero-) lateralen Vorgehen auf skalenovertebralem Wege sei der Plexus *brachialis* unnötig ge-

¹ Diese sowie den *Truncus thyroocervicalis* bekommt man nicht zu Gesicht, sie werden mittels des abgezogenen *M. scalenus anterior* nach medial verlagert.

fährdet, werde er ihm nicht zuzumutenden Druckschäden ausgesetzt. Das Nervengeflecht braucht man gar nicht beiseite zu halten, nur die ihm gegenüber liegenden Gebilde sind nach vorn-unten und medial zu verlagern, abzuziehen. Auch dem nur hoch oben (C. 3—5) am lateralen Rande des M. scalenus anterior befindlichen N. phrenicus droht unten keine Gefahr.

Nach anfänglichen Leichenversuchen hat sich mir die laterale, skalenovertebrale Stellektomie auch am Lebenden bewährt. Mir scheint der (antero-) laterale Weg zum Ggl. stellatum, immerhin nicht der kürzere, sei nicht mit den Gefahren der rein-vorderen Operationen verknüpft. Sie sei wenigstens gleich sicher im Auffinden des Ganglions ohne dass demzuliebe andere Gefahrenmomente eingetauscht werden. Sie befolgt schliesslich annähernd den Weg den die Nadel bei der freihändigen Punktion des Ganglions nach LERICHE nimmt. Die Punktion mittels des PHILIPPIDESchen Zielbügels durchdringt allerdings die Weichteile der Halsbasis mehr in dem Sinn der medialen, rein-vorderen, offenen Operation.

Die Stellektomie auf skalenovertebralem Wege reiht sich dem LAUWERSschen oberen Vorgehen auf die erste Rippe und die Pleurakuppel in der chirurgischen Behandlung der Lungentuberkulose an. Da die Stellektomie kein weiteres Heruntergehen als bis an den Hals der ersten Rippe erfordert sind die Einwände die der LAUWERSschen oberen Operation entgegengebracht wurden und derselben kaum weitere Verbreitung eingetragen haben, hier nichtig. Sie ist auch dem operativen Angriff der ersten Strecke der A. vertebralis nach DRÜNER verwandt.

Der Eingriff vollzieht sich in oberflächlicher örtlicher Betäubung in halbsitzender Lage mit von der Operationsseite abgewendetem Gesicht. Vor etwaiger Pleuraverletzung hat man sich, wie sonst, zu hüten.

In wie weit die FOERSTERsche Durchschneidung des Grenzstranges unter dem 2. Brustganglion — die den Horner vermeidet — berufen ist die Stellektomie zu ersetzen, das heisst Dauererfolge zeitigt, bleibt abzuwarten.

Zusammenfassung.

Es wird empfohlen das Ganglion stellatum mittels eines tiefen, supraklavikularen, teilweisen Kragenschnittes seitlich von (hinter) dem M. scalenus anterior »auf skalenovertebralem Wege« late-

ral anzugehen und dabei die unteren Plexuswurzeln als Leitgebilde mit zu benutzen. Da das Interstitium zwischen Kopfwender und vorderem Skalenusmuskel beim lateralen Eingriff unberührt bleibt sind Nebenverletzungen besonders des Ductus thoracicus hier, sowie auch tiefer in der Wunde nicht zu befürchten. Der kürzere, rein vordere, mediale Weg ist nicht der beste.

Summary.

It is recommended that the Ganglion stellatum be approached via a low, supraclavicular, partly, »necklace«-transverse incision, lateral from the M. scalenus anterior along the scalenovertebral space. In this way the caudal plexus roots are taken as indicators. As the intermediate space between the M. sternocleido mastoideus and M. scalenus anterior is avoided, there is no risk of injury, namely, to the Ductus thoracicus at that point as well as deeper, in the wound. The shorter, anterio-medial way is not the best.

Résumé.

L'auteur recommande d'approcher le ganglion stellaire au moyen d'une incision basse, supraclaviculaire partielle en col, latérale par rapport au muscle scalénus antérieur: par voie «scalénovertébrale». Les racines caudales du plexus servent en même temps d'indicateurs. Comme l'espace intermédiaire entre le muscle sternocléido-mastoidien et le muscle scalenus antérieur est évité, les endommagements particulièrement ceux du ductus thoracique à cet endroit et plus bas ne sont à craindre. La voie plus courte par devant et médiale n'est pas la meilleure.

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From the Medical-Physiological Institute
of the Copenhagen University.
(Chief: E. LUNDSGAARD, M. D.)

Experiments on Oxygen Therapy in Experimental Meteorism.¹

By

AXEL RINGSTED, M. D., and KJELD ANDERSEN.

Distension in the case of ileus may vary greatly, and it seems to depend on the pathogenesis of the ileus and the seat of the obstruction as well as on the duration of the condition.

Gas distension in paralytic ileus is always a dominant symptom. Gas distension in mechanical ileus is usually a subordinate symptom when the obstruction is high up in the small intestine, whereas with slowly-developing stenosis in the lower part of the colon it may become just as serious as in pronounced paralytic ileus.

Serious distension of the bowel by either gas or fluid, or as in most cases by a mixture of gas and fluid, involves various deleterious effects of general and local character. They are described briefly below.

Injurious Effects of Gas Distension on the Organism.

By elevating the diaphragm abnormally high into the thoracic cavity and inhibiting its depression during inspiration, distension has an unfavourable effect on the activity of the lungs and heart (reduced ventilation, reduced minute volume). As reduced circulation *ceteris paribus* entails reduced blood supply to the intestine, and thereby reduced absorption of the distending bowel gas, the result is a *circulus vitiosus*.

¹ This work has been aided by a grant from the P. Carl Petersen Foundation, for which we wish to express our thanks.

Of much greater importance as a rule, however, are the local consequences of the distension on the intestinal wall itself.

Experimental investigations by CUTTING 1928, ZWALENBURG 1907, GATCH, TRUSLER & AYRES 1927, and WANGENSTEEN 1937 have shown that when distension occurs, the intestine is shortened and its weight increases, while the limit of its elasticity is reduced. Intra-intestinal pressure increases, especially in the colon, and involves a reduction of the portal circulation. The reason for this is that with obstruction of the colon the part of the colon orally to the obstruction forms a closed loop, because sphincter ileocecalis permits the contents of the small intestine to pass only from that intestine into the colon. If the increased pressure persists for any length of time, the result is increased secretion, reduced absorption through the wall, oedema of mucosa, later on petechiae, sometimes necrotic areas with transperitoneal permeability and abolished Faradic reaction.

WANGENSTEEN 1937 advances transperitoneal permeability as the presumable cause of death from simple obstruction-ileus with *considerable distension*.

In practice we are familiar with spontaneous necrosis of the intestinal wall together with perforation, most often in the caecal region, as a consequence of great distension in colonic ileus.

From these clinical and experimental observations it appears that gas distension eo ipso involves a number of deleterious effects on the organism, some local, some general, the most serious consequences: ileus intoxication, peritonitis resulting from permeability of the intestinal wall, and perforation of the colon, being observed in the case of distensions with a relatively great increase of pressure or of prolonged duration.

A natural consequence of our widened knowledge of these matters has been that new methods for treating ileus have been explored in recent years, especially WANGENSTEEN's suction drainage and some experiments on oxygen treatment of gas distension in experimental ileus.

In WANGENSTEEN's suction-drainage method a jejunal sound is introduced, if possible right down to the seat of the obstruction, whereafter fluid and gas are removed from the distended intestinal loops. Without embarking upon a discussion and criticism of this method which, employed on the right indication, undoubtedly has its good aspects, we would point out that it is useless in the paralytic forms of ileus.

The other non-operative method for the treatment of ileus is the oxygen method, devised by FINE, SEARS & BANKS in 1935.

Theory of the Oxygen Method.

Comprehension of the theoretical background presupposes a knowledge of the physical nature of the gases in the organism, a subject which we have treated exhaustively in a previous work (ANDERSEN & RINGSTED 1943); we shall therefore refer to that work for details.

Clinical analyses of gas from obstructive ileus in the small intestine and colon and from patients with paralytic ileus have shown that nitrogen is by far the principal component of the gas (McIVER, BENEDICT & CLINE 1926). WANGENSTEEN 1937, and ANDERSEN & RINGSTED verified this by finding that flatus from patients with post-operative meteorism contained 80—90 per cent. N_2 . Varying low values were found for the other gases, CO_2 , O_2 , CH_4 and H_2 , especially for the last two. The very low values of the slowly-absorbable gases (CH_4 and H_2) are of importance to our knowledge of the manner in which meteorism develops. For, as was pointed out in our previous communication, it is unreasonable to think that the volume of gas in the intestine can grow through diffusion of nitrogen from the blood into the intestine, unless the slowly-absorbable gases such as hydrogen and methane form at least 10 per cent. of the bowel gas.

As N_2 represents the main constituent of the gas in obstructive distension and in our opinion almost exclusively originates from swallowed air (ANDERSEN & RINGSTED 1943), and as N_2 is slowly absorbable, it is very possible that the spontaneous absorption of the gas through the intestinal wall is unable to keep pace with the increase caused by swallowing in the case of ileus, so that the distension is aggravated.

The principle of the oxygen method is to lower the sum of the partial tensions in the tissues and thereby promote absorption of the gas held in the bowel. If the patient breathes pure oxygen the nitrogen tension in the blood will soon drop to 0.¹ If under such conditions the intestine contains gas of the ordinary composition, i. e. with a nitrogen content of up to 90 per cent., the partial pressure of the nitrogen in the intestinal gas will be about 640 mm/Hg., and consequently the difference in pressures whereby the nitrogen diffuses from intestine to tissue

¹ SHAW (unpublished data quoted by FINE, FREHLING & STARR, J. Thor. Surg. Vol. 4, 635, 1935) demonstrated that the N_2 tension in arterial blood on respiration in pure oxygen after four hours had fallen from 573 to 31 mm/Hg.

and blood will be 640 mm/Hg. When one breathes atmospheric air the nitrogen tension in the blood is about 570 mm. Hg., and the pressure difference that causes the nitrogen to diffuse from intestine to blood is consequently only about 70 mm. Hg. By breathing pure oxygen it should thus be possible to increase the nitrogen absorption almost tenfold. When one breathes pure oxygen the oxygen tension in the arterial blood is greatly increased; but as soon as the blood in the capillaries begins to diffuse oxygen, the oxygen tension will drop rapidly, so that the oxygen tension in the venous blood and in the tissues will be practically the same as when one breathes in atmospheric air. During oxygen breathing the sum of the partial tensions in the venous blood will be: CO_2 46 mm. Hg. + O_2 40—45 mm. Hg., i. e. about 90 mm. Hg., whereas the sum of the partial tensions in the venous blood when breathing in atmospheric air is: CO_2 46 mm. Hg. + O_2 35—40 mm. Hg. + N_2 570 mm. Hg., i. e. about 650 mm. Hg.

A further consequence of the oxygen method is that the air swallowed after the oxygen therapy is instituted will be oxygen, and this, owing to its higher absorption coefficient *ceteris paribus* will be absorbed much more rapidly than nitrogen.

In a number of experiments on cats FINE et al. 1935 demonstrated that if the small intestine is ligated at the pylorus and the ileo-caecal junction, and this closed intestinal loop is filled with pure N_2 , more than 60 per cent. will have been absorbed after respiration for 24 hours in pure oxygen, whereas control animals breathing atmospheric air absorbed only 10 per cent. FINE et al. 1936 considered that this result is due partly to a quicker diffusion of N_2 from the bowel into the blood, but especially to the diffusion of N_2 , which they assert proceeds in the opposite direction, now having ceased. We do not accept this latter interpretation and shall revert to it later.

In their above work FINE et al. 1935 also investigated conditions in the stomach and found that there is practically no absorption of N_2 from the stomach (only about 10 per cent.), even with 24 hours' respiration in oxygen, a finding that is best explained by difference in the size of the absorbing surface. On the other hand, FINE et al. (1935—1936) did not investigate absorption in the colon. As the structure of the colon is different from that of the small intestine, and as colonic ileus is the predominant form of ileus cases, we judged it to be of interest to in-

investigate conditions in that organ. We have also investigated the oxygen-respirations differing somewhat from those of FINE et al.

An account of these experiments will be given below.

Experimental Technique.

We employed white and pied rabbits (2.0—2.5 kg.), and in a few cases cats.

The rabbits were given mixed feed.

During the last two to six days prior to the operation they received no food. As a result the small intestine as a rule became empty except for a few semi-solid particles in the lower part of the ileum. The small intestine of the cats was quite empty. Where inanition lasted more than two days we administered glucose-saline subcutaneously in suitable doses; during the course of the experiment, i. e. while they were in the oxygen chamber — from one to two days — all the animals fasted.

As we had to employ animals that had fasted for several days, the intestinal tract was quite empty of gas as a rule. For the purpose of securing a distension similar to that observed in clinical ileus we filled a section of the intestine between two ligatures with atmospheric air, N_2 or O_2 until sufficient distension was obtained. The animals were then placed in the oxygen chamber with varying concentrations of oxygen; they remained there as a rule for 24 hours — in a few cases 48 hours.

The operations were performed under aseptic conditions, the rabbits being narcotized with allypropynal, the following solution being used: allypropynal g. 2.5. 0.5 n-NaOH c. c. 23.8 sterile distilled water gr. 50. Dose about 2—3 c. c., ether was used for the cats.

The operation consisted of the establishment of a so-called closed intestinal loop. In order to avoid too many variable factors when making comparisons we always employed the same length and section of the bowel and the same quantity of air, the anal ligature being placed on the ileum opposite the point of the appendix, and the oral ligature 50 cm. proximally of it (in a few cases only 25 cm.). If not already empty the intestine was previously stripped empty of gas and fluid, whereafter it was filled with the gas required, sufficient to distend the section to the thickness of an index finger. It is our experience that rabbits

are intolerant of the introduction of more than about 50 c. c. of air, whereas cats will take 100 c. c. without difficulty.

The ligatures employed were elastic bands, which in our experience never cut through. The air is inflated into the closed loop through a morphia cannula plunged obliquely through the wall, which becomes airtight again after the removal of the needle.

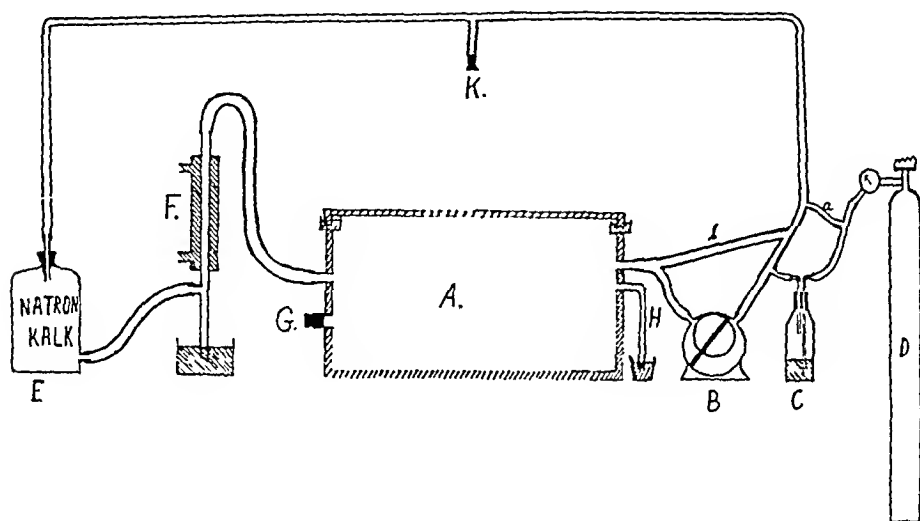


Fig. 1.

The oxygen chamber (fig. 1) is an airtight box A with a removable glass lid which a water-trap makes airtight. At both ends the chamber is connected with a closed pipe system which in one direction leads to the vacuum pump B which keeps the air in the system circulating during the experiment (about 2 litres a minute). From the air pump the system runs on to the sodium calcium container E (carbon dioxide absorption), on the way being fed constantly through the washing-bottle C with oxygen from the cylinder D (about 4 litres an hour). The period of the experiment was 24 hours. From E the air stream on its way back to the oxygen chamber passes through the water cooler F, where the vapour is condensed. After the animal has been placed in the chamber, oxygen is blown through direct from the cylinder, by-passing the washing-bottle and the air pump, i. e. through the pipe a—b. This oxygen escapes through G. About 150—200 litres of oxygen are blown through the chamber, which brings the oxygen concentration in it up to about 98—99 oxygen volume per cent. This done, the closed system is linked up, G being

closed and a and b shut off with clamps. The excess of air escapes through H, as more oxygen is supplied than the animal requires; by this means it is ensured that atmospheric air cannot be sucked into the chamber. As soon as the experiment is started air is taken through K for analysis, and again just before the conclusion. In the Table the mean value of the two analyses is shown as the average oxygen percentage. The gas analyses were made with Petterson's apparatus.

At the end of the experimental period the animals are killed by a stab into the medulla oblongata, the abdomen is opened, the closed loop removed, and the intestine opened in such a manner that the gas content by means of a funnel-shaped water-filled system can be collected in a measuring glass, where readings can be made under atmospheric pressure. In most cases the animals were lively and apparently well while in the oxygen chamber, even in the few cases where the experiment was extended to two days.

Experimental Results.

Knowing the absolute diffusion velocities of oxygen and nitrogen from previous work (ANDERSEN & RINGSTED 1943) and the respective tensions of these gases in the tissues (O_2 about 35 mm., and N_2 about 570 mm.), one anticipates that swallowed air or atmospheric air blown into the intestine will be absorbed, the relatively easily absorbable O_2 being absorbed quickly, whereas the nitrogen is absorbed very slowly. This anticipation is borne out by our gas analyses from a clinical ileus material (ANDERSEN & RINGSTED 1943). Thus it will be the absorption of N_2 during oxygen respiration that is of significance. Our first experiments were therefore made with N_2 in the bowel.

As it is the idea of these experiments to apply them in the clinic, where the oxygen concentration cannot be expected to be higher than 75—85 per cent. with either oxygen mask (BANG 1940) or oxygen tent, we tested the N_2 absorption partly under respiration in atmospheric air (the control material), partly at high oxygen concentrations (85—100 per cent.), and partly at lower concentrations (60—70 per cent.). The results of these experiments are shown in Tables A, B and C.

I. Experiments with pure N_2 in a closed intestinal loop during respiration in atmospheric air (Table A).

A priori it is to be expected that pure N_2 introduced into the bowel will diffuse into the blood stream of the control animals, i. e. animals breathing in atmospheric air during the entire course of the experiment, the reason being that pure N_2 in the bowel will have a higher partial pressure, 713 mm. (i. e. 760 mm. less 47 mm., the pressure of saturated vapours) than N_2 's tension in the blood, i. e. 563 mm. For the purpose of preliminary orientation as to this spontaneous absorption of N_2 during respiration in atmospheric air, we made four experiments (Table A) with varying quantities of N_2 blown into the same length of intestine. This secures varying degrees of distension.

Table A.

Control experiments with pure N_2 in intestinal loop (atm. air).

No.	Weight kg.	Inanition (24 hrs)	Length of int. cm.	Inject. N_2 c c.	Gas residue c. c.	Absorp- tion %	Duration of experi- ment hrs.
203	2.3	1	50	48.5	44.5	8.8	24
207	2.0	1	50	49.0	46.0	6.1	24
210	2.5	1	50	30.0	26.5	11.6	24
216	2.4	3	50	33.0	28.8	11.8	24

The results, as Table A shows, were that the absorption of N_2 from a 50 cm. length of intestine on the whole is slight in the course of 24 hours (6.1—11.8 per cent., average 9.4 per cent.). It will also be seen that the percentage of absorption is highest in the two experiments in which the bowel was distended least (rabbits 210 and 216), which may be due to the fact that better blood supply per superficial unit of intestinal wall in the less distended intestine more than compensates for the greater area of contact between air and intestinal wall in the more distended bowel. In no case did we observe any increase of the bowel gas.

II. Absorption of pure N_2 from a closed loop during respiration in the oxygen chamber with high O_2 concentrations (Table B).

These experiments show that there was a very great increase in the percentage of N_2 absorption during respiration in high O_2 concentrations.

On comparing Tables A and B we find that when the percentage of oxygen in the respiration air rises from 21 (corresponding to atmospheric air) to 93.7, the percentage of N_2 absorption rises seven-fold.

Table B.

Experiments on absorption (diffusion) of pure N_2 from the small intestine of rabbits in the oxygen chamber with a high O_2 percentage.

No.	Weight kg.	Inanition (24 hrs)	Length of int. cm.	Inject. N_2 c. c.	Gas residue c. c.	Absorp- tion %	Duration of experi- ment hrs.	Average O_2 %
206	2	1	50	48.5	13	71.3	22	86.8
208	2.3	1	50	49.0	18	63.3	23	92.4
209	2	2	50	30.0	11.5	61.7	24	88.5
215	2.4	3	50	48.0	10.5	78.1	24	98.5
217	2.4	3	50	49.0	17.5	64.9	23½	99.0
218	2.3	3	50	49.0	13.5	72.5	25½	98.6
						68.4		93.7

III. Experiments on the absorption of pure N_2 from a closed loop during respiration in the oxygen chamber with oxygen concentrations of 60—65 per cent (Table C).

Table C.

Experiments on absorption (diffusion) of pure N_2 from the small intestine of rabbits in the oxygen chamber at about 65 % O_2 .

No.	Weight kg.	Inanition (24 hrs)	Length of int. cm.	Inject. N_2 c. c.	Gas residue c. c.	Absorp- tion %	Duration of experi- ment hrs.	Average O_2 %
204	2.2	1	50	48.5	23.7	50.9	23	ca. 65
211	2.5	3	50	49.0	6.7	86.3	21	69.6
212	2.3	3	50	44.0	10.0	77.3	24	67.0
219	2.3	7	50	48.5	17.0	65.0	23	59.0
220	2.3	2	50	49.0	24.0	51.0	24	62.9
221	2.4	4	50	49.0	24.0	51.0	24	59.5
						63.6		63.8

In Table C we see better conformity between the oxygen concentration and the absorption percentage, the two highest absorption percentages being collateral to the two highest oxygen concentrations, and two of the lowest to two of the three low oxygen concentrations.

On comparing the average values of the absorption percentages at high and low oxygen concentrations (B and C respectively) we observe only a slight increase in the absorption percentage (63.6—68.4) when there is a considerable increase in the oxygen concentration (63.8—93.7), and one might be induced to conclude that an increase beyond the oxygen concentration of about 65 per cent. would not increase the percentage of absorption very much. That this is not so will be seen on comparing the high oxygen concentrations (Table B Nos. 215, 217 and 218) with the three lowest (Table C Nos. 219, 220 and 221). Here we find a very considerable increase, i. e. from 55.7 per cent. to 71.5 per cent. of the absorption percentage on increasing the oxygen concentration from just over 60 to 98—99 per cent.

Thus the small materials with their great variations are apt to conceal the importance of keeping the oxygen concentration high; but we consider that the importance of doing so is a real one.

IV. Experiments on the absorption of pure oxygen in a closed loop during respiration in the oxygen chamber with high oxygen concentrations (Tables D and E).

As the air swallowed during the application of oxygen therapy will be oxygen, we have made some few experiments to determine the velocity of the absorption of the oxygen during oxygen respiration. In order to obtain a quantitative expression for the oxygen absorption we again tested the absorption of a measured quantity of oxygen in a closed loop (Table D) and, for the sake of comparison, employed the same volumes and sections of the small intestine as in the experiments with pure N_2 .

Table D.

Experiments on the absorption of pure O_2 from closed loops in rabbits in the oxygen chamber at 98 per cent. oxygen.

No.	Weight kg.	Inanition (24 hrs)	Length of int. cm.	Inject. O_2 c. c.	Gas residue c. c.	Absorp- tion %	Duration of experi- ment hrs.	Average O_2 %
224	2.1	4	50	49	1	ca. 100	24	98.0
225	2.4	5	50	50	0	100	24	98.8
						100		98.4

Table D shows that the absorption of oxygen from the bowel of animals breathing pure oxygen proceeds rapidly, all the oxygen being absorbed in the course of 24 hours. It is possible that absorption was complete at a much earlier juncture; this small series reveals nothing of this. It shows merely that if pure oxygen is swallowed or introduced into the intestinal tract in the course of treatment with oxygen (oxygen chamber, oxygen tent), this oxygen will be absorbed more rapidly and more completely than if pure N_2 is swallowed (see Tables B and C). It will also be absorbed more quickly than if atmospheric air is swallowed (see later). Thus by this means too the oxygen treatment will diminish the accumulation of gas in the intestinal tract of an animal with ileus. This is clearly confirmed by the following experiment. In a previous work (ANDERSEN & RINGSTED 1943) we established a mechanical ileus in a number of animals by ligating at loens electus on the ileum and allowing them to live with it for two to five days in atmospheric air. Some of the animals were not fed after the obstruction had been established. These animals had only small quantities of gas, or none at all, in the small intestine. Other animals received food ad lib. after the operation, and these had large quantities of gas in the small intestine. On placing such an animal (No. 260) in the oxygen chamber instead of in atmospheric air, it was found that no gas came into the small intestine and only insignificant quantities into the stomach, even when the animal had eaten well.

In these experiments on rabbits we had only injected volumes of air corresponding to $\frac{1}{4}$ th— $\frac{1}{5}$ th of the length of the small intestine, experience having taught us that rabbits only badly tolerate sudden large distension.

We now desired to test oxygen therapy by means of a distension involving the whole or most of the small intestine, corresponding to the clinical condition in cases of paralytic ileus with distension of the major part of the intestinal tract. For this purpose we employed cats, which proved to be able to tolerate the operation well. Otherwise the technique was the same as that described above. The small intestine was distended with air to just over the thickness of an index finger, and ligatures were placed just below the pylorus and at the ileo-caecal junction. The results are shown in Table E, which shows that after 24 hours oxygen therapy the percentage of absorption agrees fairly well with the values obtained from the rabbit experiments with high

Table E.

Experiments on the absorption (diffusion) of atmospheric air from the small intestine of cats in the oxygen chamber with high O₂ percentage.

No.	Weight kg.	Inanition (24 hrs)	Length of int. cm.	Inject. atm. air c. c.	Gas residue c. c.	Absorp- tion %	Duration of experi- ment hrs.	Average O ₂ %
1	2.7	1	whole small int.	100	37.5	62.5	24	98.9
2	3.0	1	,	100	0	100	48	98.5

oxygen concentrations (Table B). After 48 hours the absorption of atmospheric air was complete. After this result there is reason for assuming that with excessive accumulations of air in the small intestine there is hope of a good effect from oxygen therapy in practice.

V. Experiment with atmospheric air in a closed colonic loop and oxygen chamber with high oxygen concentrations (Table F).

Pathological accumulation of gas in the colon is a very common phenomenon in a number of types of colonic ileus (colonic stenosis, volvulus, paralytic ileus, internal incarceration). In the colon, especially in the case of stenosis, the accumulation — and koprostasis — often is much greater than in the small intestine, because during the development of ileus it is not so early accompanied by alarming symptoms as ileus of the small intestine, when nausea and vomiting quickly appear, followed by faeculent vomiting.

Where valvula Bauhini is sufficient for a high intra-colic pressure, no air will be regurgitated into the small intestine, but the contents of the small intestine and air will constantly be forced into the colon by peristalsis. Stagnation in the contents of the colon may also cause abnormal fermentation in the organ, which will increase the distension. This abnormal distension of the wall of the colon reduces its nutrition, and the reduced blood supply involves reduced absorption of gas and fluid. In cases of greatly distended colon, especially in elderly people, the intestinal wall may be injured so much as to allow the passage of bacteria, which results in peritonitis, or, owing to ischaemia in the tissues, necrosis of the colon wall may set in, especially in the caecal

region (WANGENSTEEN 1937), with spontaneous perforation as a consequence.

After resection of the colon it is also of importance to be able to reduce the post-operative distention in order that the sutures may hold. Finally, in those cases of paralytic ileus where the colonic distension is the dominant factor, it should be possible for oxygen therapy to break the vicious circle which is a deciding factor in the pathogenesis of paralytic ileus. All this shows how important it is to have a method which, by non-operative means and without being conditioned by greatly increased peristalsis, is capable of reducing the distension.

We have made only two experiments of this kind, on rabbits, as the results are exactly the same.

Technique. Entry is made by Lap. med. inf. After having squeezed out any air bubbles in the selected sector we placed a double ligature on the intestine itself at a distance of 25 to 50 cm. and then inflated the closed loop with atmospheric air until it was about the thickness of an index finger. The animals were then placed in the oxygen chamber for 24 hours, a high oxygen concentration being maintained (97—99 per cent.).

Table F.

Experiments on the absorption of atmospheric air from colonic loop in rabbits in the oxygen chamber at about 98 % O₂.

No.	Weight kg.	Inanition (24 hrs)	Length of int. cm.	Inject. atm. air c. c.	Gas residue c. c.	Absorp- tion %	Duration of experi- ment hrs.	Average O ₂ %
228	2.0	4	25	30	4	86.7	24	97.7
229	2.0	6	50	80	10	87.5	24	98.5
						87.1		98.1

It appears from Table F that the absorption of atmospheric air from the colon is very great and that it proceeds rapidly, just under 90 per cent. being absorbed in the course of 24 hours. This percentage exceeds all our previous results with the small intestine. In this connection it is of special interest that the result is still better than that obtained with the small intestine of the cat under the same experimental conditions, as it must be borne in mind that the small intestine of a cat has a better blood supply and has villi.

Discussion.

As already stated, it is the velocity of absorption of nitrogen that determines how quickly a gaseous mixture such as that contained in the bowel in spontaneous and experimental ileus is absorbed. Our experiments now show that the absorption of the nitrogen proceeds very slowly, so slowly that the air swallowed during the experimental period by a rabbit with ileus — provided it eats — will as a rule greatly exceed the quantity of nitrogen absorbed (ANDERSEN & RINGSTED 1943).

All the experiments on oxygen therapy show that the percentage of N_2 absorbed rises rapidly and on the whole proportionately to the oxygen percentage in the respired air. In Table B we see that when the oxygen concentration rises from 21 per cent. (the percentage of oxygen in atmospheric air, Table A) to 93 per cent., the percentage of N_2 absorption rises seven-fold. This experiment on rabbits confirms the results of FINE et al. (1935) from cat experiments and shows that the increase in the velocity of nitrogen absorption which is obtainable by the respiration of oxygen is considerable. The interesting point is the increase of the percentage of N_2 absorption to such dimensions that it is justifiable to anticipate that oxygen therapy will be of practical importance in the clinic.

Table C shows that even with oxygen concentrations of about 65 per cent. — concentrations easy to establish and maintain in practice (oxygen tent, DAUTREBAND's oxygen mask (BANG 1940) — there is considerable N_2 absorption, two-thirds of the air in the bowel being absorbed in the course of 24 hours. On comparing Tables C and B one wonders that the percentage of absorption has risen only 5 per cent. whereas the oxygen concentration is higher by 30 per cent. A much greater increase would have been expected. The explanation undoubtedly is the numerically small series of experiments, in which individual reactions¹ affect the average disproportionately. As we have said on a former occasion, we consider that the dependence of the N_2

¹ The individual oscillations will be understood when it is remembered that these animals, apart from their air-distended, closed intestinal loop, have a mechanical ileus, which often shocks them. Consequently one must reckon with lowered circulation and reduced blood supply to the intestinal wall in those that are more affected, and this will involve differences in the absorption percentage under experimental conditions otherwise equal.

absorption percentage on the oxygen concentration is a reality. In contradistinction to FINE et al. (1935), who consider that under normal circumstances N_2 diffuses from the blood into the bowel and causes an accumulation of gas there, and therefore explain the action of oxygen therapy as a cessation of this endogenous formation of gas in conjunction with increased absorption from the bowel into the blood stream, we believe that oxygen therapy works by increasing the fall of the tension with regard to nitrogen from bowel gas to the blood, so that the absorption of nitrogen is increased. A more secondary and prophylactic factor is, moreover, that the air swallowed during oxygen treatment is oxygen, which is absorbed much more quickly than nitrogen.

Our experiments with oxygen in a closed loop and with swallowed oxygen in the case of mechanical ileus show that the oxygen absorbs more rapidly than N_2 and completely in the course of 24 hours — possibly before. Consequently, in this manner too, oxygen therapy will reduce the gas accumulation in the bowel.

As was stated in the introduction, we consider that paralytic ileus would be one of the chief indications for oxygen therapy. Being unable to produce paralytic ileus in rabbits with a constancy sufficient to permit of a successful experiment, we reproduced the conditions of paralytic ileus by distending the whole of the small intestine. For this purpose we had to use cats, as rabbits are unable to tolerate the operation. We are aware that this reproduction is very incomplete, because the etiological factors (toxic influence, circulatory debility, etc.) which involves the atony of the intestinal wall, and the abolished peristalsis, are not represented in the experiment. These experiments merely tell us that the organism is capable of absorbing quantities of air so great that they may be compared with the quantities present in human paralytic ileus, and that absorption proceeds at approximately the same velocity, whether the entire small intestine or only a small part of it is distended.

In our experiments on absorption from a distended colonic loop we observed an absorption velocity which exceeds the velocity from the small intestine of the rabbit by 25 per cent. No doubt this rapid absorption is due partly to the fact that here it was atmospheric air, of which 21 per cent. is represented by the more easily absorbable oxygen; but it can by no means explain the whole difference. Nor can the slightly higher oxygen

concentration in the colon experiments explain it. We are bound to assume that the more muscular and powerful wall of the colon absorbs better, or at any rate just as well as the small intestine, presumably on account of the better blood supply.

Possibilities of Oxygen Therapy in the Clinic.

The principal indication undoubtedly will be paralytic ileus where the usual treatment fails and where the patient is in such a low state that spinal anaesthesia or enterostomy is out of the question, or where the usual peristaltic and intestinal tonics are counter-indicated, for example in cases of intraperitoneal abscess or limited peritonitis, where the bowel is to be brought into a state of quiescence, but at the same time have its tone restored. In adhesive ileus, when there is definitely an obstruction, and when it is desirable to postpone operation for some reason, there may also be an indication for oxygen therapy in support of a WANGENSTEEN treatment.

It may also be indicated after intestinal operations as a prophylactic for counteracting postoperative distension, which of course involves a danger to the sutures, especially in the colon. Therefore it is a most interesting observation that the colon is so greatly absorbent as our experiments have shown it to be.

FINE, BANKS & HERMANSON (1936) reported on five cases of paralytic ileus (peritonific, reflectoric) in which intermittent treatment with inhalation of 95 % oxygen in the course of 24—48 hours brought about such an absorption of gas that intestinal motility was regained. No deleterious effect from the oxygen treatment was observed. EVANS & DUSHORDWE (1932) observed a rapid improvement of the meteorism in patients with pneumonia and pronounced anoxaemia when treated with inhalation at 95 %. They consider, however, that the anoxaemia is the cause of the distension and that this distension subsides when the anoxaemia is abolished.

Finally, we may mention traumatic subcutaneous emphysema, where this assumes a threatening character calling for operative measures. As the laws applying to the absorption of air in the bowel will doubtless apply to air which has made its way into the tissues, there is a possibility of substituting oxygen therapy for operation. It is possible, however, that the effect will be slower than in the intestine, as it will depend on the blood supply to the tissue.

Summary.

1. The authors summarize the injurious local and general consequences of serious distension of the intestinal tract, in particular ileus intoxication, perforative peritonitis, and colon perforation.

2. Various non-operative methods of treating ileus are referred to. An account is given of the principle involved in the action of oxygen therapy.

3. Own experiments with oxygen therapy in various forms of experimental meteorism on rabbits and cats are described. They show that treatment in the oxygen chamber increases the absorption of bowel gas very considerably. With high oxygen concentrations there is an absorption seven times greater than that recorded for respiration in atmospheric air. The results hold good for both small intestine and colon.

4. The experimental results are discussed and various possibilities for the use of oxygen therapy in the clinic are mentioned, particularly the importance of treating paralytic ileus and post-operative distension after operation on the colon.

Zusammenfassung.

1. Die Verff. fassen die schädlichen, örtlichen und allgemeinen Folgen einer starken Aufblähung des Darmkanals, besonders bei Ileusintoxikation, Perforationsperitonitis und Kolonperforation, zusammen.

2. Es werden verschiedene unblutige Methoden zur Behandlung des Ileus erwähnt. Über das der Wirkung der Sauerstofftherapie zugrunde liegende Prinzip wird berichtet.

3. Eigene Experimente mit Sauerstoffbehandlung bei verschiedenen Formen von experimentellen Meteorismus bei Kaninchen und Katzen werden beschrieben. Diese zeigen, dass die Behandlung in der Sauerstoffkammer die Absorption von Darmgasen sehr bedeutend vermehrt. Bei hoher Sauerstoffkonzentration ist die Absorption siebenmal so gross als bei Atmung in atmosphärischer Luft. Diese Ergebnisse gelten sowohl Dünndarm als auch Colon.

4. Die experimentellen Ergebnisse werden besprochen und verschiedene Möglichkeiten der Verwendung der Sauerstofftherapie

in der Klinik erwähnt, besonders die Bedeutung der Behandlung des paralytischen Ileus und der postoperativen Aufblähung nach Kolonoperationen.

Résumé.

Les auteurs résument les conséquences pathologiques locales et générales de la distension grave de l'intestin, entre autres l'intoxication par iléus, la péritonite perforante et la perforation du colon.

2. Ils exposent également les diverses méthodes non-chirurgicales de traitement de l'iléus. Ils donnent un aperçu du principe impliqué dans la thérapeutique par oxygénation.

3. Ils décrivent des expériences personnelles de thérapeutique par oxygénation dans diverses formes de météorisme expérimental chez des lapins et des chats. Ils démontrent que le traitement dans la chambre à oxygène augmente très considérablement l'absorption de gaz intestinal. Avec une concentration élevée de l'oxygène, l'absorption est sept fois plus forte que celle notée pour la respiration dans l'air atmosphérique. Les résultats furent favorables tant pour l'intestin grêle que pour le colon.

4. Ils discutent les résultats expérimentaux et examinent les diverses indications de la thérapeutique par l'oxygène en clinique, spécialement l'importance du traitement de l'iléus paralytique et la distension après intervention chirurgicale sur le colon.

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From the University Clinic of Surgery C, the Rigshospital, Copenhagen.
(Surgeon-in-Chief: Professor E. Dahl-Iversen, M.D.) and
the Radiological Department of the Rigshospital
(Chief: Professor Flemming Møller, M.D.)

Primary Thrombosis of the Axillary Vein.

7 Verified Cases of Thrombus Formation.

By

EJNAR ROELSEN.

In a preceding paper the writer (1938) called attention to a syndrome which at that time was known or recognized but little here in Denmark, consisting of the following symptoms:

1) More or less acute onset of swelling of an upper extremity, from the hand to the shoulder, involving the entire extremity diffusely. The consistence of the arm is firmly elastic, tense, without any oedema proper, *i. e.*, non-pitting on digital impression.

2) Dilatation and congestion of the subcutaneous veins of the arm and pectoral region, with a more or less pronounced cyanotic hue of the hand and arm.

3) Often slight tenderness corresponding to the axillary vein, slight sensation of heaviness or slight pain in the arm, sometimes with reduction in muscular power.

4) Often a history of preceding heavy or unwanted muscular work with the arm involved.

5) Marked tendency to aggravation or recurrence of the condition on continuation or too early resumption of the work giving rise to the attack.

6) Negative palpation and roentgenography as to explanation of the appearance of the stasis.

7) Absence of general symptoms, in particular absence of signs of diseases of the blood or infection.

This syndrome, which is the expression of a more or less acute venous stasis, has been designated by various terms in the literature, where at this writing, I think, more than 150 cases have been published: traumatic thrombosis of the axillary (subclavian) vein, exertion thrombosis or thrombophlebitis of the axillary (subclavian) vein (thrombose par effort), primary thrombosis of the axillary (subclavian) vein or "so-called" thrombosis of the axillary (subclavian) vein. The various authors are far from agreeing in their explanation of the etiology and pathogenesis of this syndrome. Previously these cases were always taken to be brought about by thrombosis of the axillary (subclavian) vein. After various recent papers (cf. LÖHR) it was realized that this syndrome very well may be encountered without the presence of any thrombosis of the vein. This has been confirmed by the writer, as 3 of 7 cases under his observation presented no sign of thrombosis on operation.

After 1938 the writer has had occasion to observe 11 additional cases of this syndrome of stasis of the upper extremity. The following 7 cases all presented definite signs of thrombus formation, on which account I find it appropriate here to report them together with some remarks that will serve as a not unessential supplement to my aforementioned paper.

No attempt will here be made at a systematic review of the literature published on this subject since 1938. The literature accessible to me has not brought anything essentially new. The continued publication of cases of this lesion is due, among other things, to the circumstance that the disease is taken to be relatively rare. But, as we have been able in 9 years to observe altogether 18 cases of this kind, the lesion cannot be very infrequent.

Case Records.

Case 1. Female, 17 years old, housemaid. Reg. No. 128/42. Admitted $18/_{11}$ — $23/_{12}$ 41.

Past History of good health.

Present Illness: In the last couple of years there has been tendency to swelling and weakness of the left arm, for instance, on sewing. 2 months before admission, following window cleaning, the entire left arm became markedly swollen, with a bluish hue. No pain in the axilla or feverish sensation. The swelling yielded to hot compresses, but since then it has recurred every time she tried to use the arm. Thus she was unable to wash herself or shine shoes with the left arm without its swelling.

Physical Exam.: Slight diffuse cyanotic swelling of the entire left upper extremity. Also slight swelling of the left infraclavicular region, with protrusion of the collateral veins here. No tenderness of the axillary vein. After 1 minute's energetic work with a clothes-brush, the entire forearm becomes the site of a diffuse bluish discoloration and dough-like swelling, these phenomena extending up on the distal two-thirds of the upper arm. Also swelling of the left humeroseapular region. *Otherwise no abnormality except for slight acrocyanosis.* No sign of organic nervous lesion.

Temperature normal, urine normal. Hemoglobin percentage and complete blood count normal. Wassermann negative. Sedimentation rate: 2 mm. Blood pressure and electrocardiogram normal.

X-ray Exam.: No sign of cervical rib. No abnormality of the heart and lungs.

Venography (about 2 months after the onset of symptoms), Fig. 2: Injection of 7 cc. of perabrodil forte into the left basilic vein gives filling of the vein to the level of the axillary fold. Here the shadow is interrupted abruptly, continuing merely as very weak and irregular streaks of contrast substance. On the other hand, there is marked retrograde filling of the deep venous network and the collaterals in the subscapular region and around the neck of the humerus. Control examination in the right side shows perfectly normal conditions.

<i>Venous Pressure:</i>	At rest.	After 45 sec. work with
		clothes-brush.
Right arm	5—10 em. H ₂ O	20—16 em. H ₂ O
Left arm	Not measured	33—28 em. H ₂ O

Course and Treatment. As venography was strongly suggestive of an occlusive lesion of the left axillary vein, on 4/12/41, under ether anesthesia, an incision was made (DAHL-IVERSEN) along the anterior axillary fold, uncovering the left axillary vein. The incision extended from the commencement of the axillary vein to 3 cm. below the clavicle. For a distance of about 5 cm., this vein was partly thrombosed, partly transformed into a fibrous cord. A small amount of fluid blood was enclosed in two places. Distally and proximally to this section, the vein was normal. The section of the vein affected was extirpated between double ligatures. A considerable degree of periphlebitis was present here. On ligation of a couple of small branches from the adjacent normal parts of the vein it was ascertained that the venous blood flow here was normal. The arteries were felt to pulsate normally. The wound was sutured. The postoperative course was uncomplicated.

Microscopic Exam. (Teilum): *The segment of vein removed* shows: thrombosis with partial organization, obliteration and recanalization.

The segment of vein removed measures 5 cm. in length, with a diameter of 5—8 mm. The thinner areas appear to be completely obliterated by firm white tissue masses. The thicker areas, on the other hand, contain fresh thrombus masses. Several cross-sections of the vein are examined microscopically. In a few sections the lumen is almost

completely obliterated, so that there remains only a central stellate lumen while the remainder is occupied by connective tissue and granulation tissue. Phagocytes with blood pigments are seen in the inner part. The wall is diffusely infiltrated with lymphocytes and histiocytes, together with the new-formed capillaries. In other sections the thrombotic changes are of a more recent date, with adherent thrombus and cell infiltration of the venous wall, in particular corresponding to the media. No evidence of any specific inflammation.

Reexamination, 1 year later: The patient has not been able to hold any job. Her left arm starts swelling on any more strenuous work as washing a lot of dishes, laundering, etc. Still, these attacks of swelling have not been as frequent as previously. Only once, when she tried to swim a rather long distance, the arm became greatly swollen and blue. She has become somewhat uneasy about her arm, presumably being afraid of a relapse. There is considerable cyanosis of both hands, especially the left. The left forearm and hand feel a little cooler than the right. The circumference of the left arm is only $1\frac{1}{2}$ cm. greater than that of the right; the circumference of the forearm is the same on both sides. Only slight venous configuration in the left pectoral region. Linear scar. 2 minutes' work with a clothes-brush gives some accentuation of the cyanotic hue of the left arm, but no particular change in its consistence. The patient is recommended to resume work in an easy job.

Case 2. Male, 35 years old, mechanic. Reg. No. 1100/42. Admitted $15/5-17/6$ 42.

Past History: 3 years ago admitted to the Med. Dep. of the Sundby Hospital for stomach trouble (tobaeco). At about the same time he had pain in the back from lifting a heavy load while working. Since, he has often had pains in the back, corresponding to the 7' cervical vertebra. Otherwise well.

Present Illness: In the night before admission, while at work, the patient noticed that the skin of the right arm was itching. When he rolled up his shirt sleeve he found the entire right arm to be thick and reddish blue with distended veins. He had a sensation of tension in the right arm, radiating up in the axilla and neck and over in the pectoral region. Still he was quite able to continue working. On the following day there was a little tenderness corresponding to the medial aspect of the upper arm and the axilla. He did not feel feverish. He is not able to attribute this attack to any particular part of his work. He previously worked as a metal cutter (gun factory); in the last couple of months he has been doing various kinds of work as mechanic, including heavy lifting — but this has not inconvenienced him. On the day before the swelling of the arm he was playing ball with his children, but not strenuously. A short time ago he received a heavy blow on the elbow.

Physical Exam.: Enormous diffuse swelling of the right upper extremity. This swelling is dough-like, not ordinarily oedematous. Distinct dilatation and tension of the axillary vein, but only slight tenderness. No adenitis. Slight reddish-cyanotic hue of the right hand. Distinct

venous configuration of the right upper arm and right pectoral region. Circumference of the right upper arm and forearm respectively 6 and 3 cm. larger than the symmetrical measure of the left arm. *Otherwise no abnormality.*

Temperature normal. Urine normal. Hemoglobin percentage and complete blood count normal. Wassermann negative. Sedimentation rate: 8 mm. Blood pressure normal.

X-ray Exam.: No sign of any cervical rib.

Venography (3 days after the onset of symptoms), Fig. 3: Injection of 10 cc. of parabrodil forte into the left medial cubital vein, in the direction towards the basilic vein. No noticeable filling of the basilic vein, as all the contrast fluid runs back through the medial cubital vein into the cephalic vein, which is filled and continues in a markedly developed collateral circulation in the deltoid region. The examination is repeated 3 days later, with the median cubital vein laid bare and injection into it against a strong resistance, in the direction towards the basilic vein. This time the basilic, brachial and axillary veins are filled partially, the contrast substance lying as a thin coat along the walls of the vessels, whereas the lumen centrally is filled with a non-shadow-giving mass which can be followed as a cord in the brachial veins from the level of the plica cubiti to the inlet in the axillary vein and for some distance proximally. One brachial vein, however, is completely occluded midway on the upper arm. A collateral venous network is seen in the deltoid region this time too, though less filled now.

Course and Treatment. As the process here concerned evidently was a very extensive thrombosis of the right brachial and axillary veins, that had lasted but a very short time, conservative treatment was decided on. The arm was placed on a slanting cushion. From $22\frac{2}{5}$ to $28\frac{2}{5}$ he was given injections of heparin, 100 mg. \times 3 daily. This increased the clotting time to 25 min. ($23\frac{2}{5}$). For 2 days the temperature was slightly elevated, round 38° ($23\frac{2}{5}$ — $24\frac{1}{5}$), then it was subfebrile for a couple of days, and after this it was normal. The sedimentation rate rose to 23 mm. ($4\frac{1}{5}$).

After venography there was slight suppuration of the wound and the patient complained a good deal of pain in the arm. These phenomena, as well as the oedema, subsided readily under the heparin treatment. The edges of the wound in the cubital fossa commenced bleeding, but the hemorrhage was checked easily by tamponade with strypon gauze. At his discharge from the hospital the swelling of the arm had subsided considerably, and the cyanosis was almost completely gone. The muscular power was reduced but little.

Reexamination, September 1943 (16 months after admission): The patient has been feeling well since his discharge. After convalescence for 1 month he has been able to attend to his work. But he can still feel that his right arm is not like the left. The circumference of the right upper arm and forearm is respectively 1.8 and 1.3 cm. greater than the symmetrical measures of the left arm. The consistence of the two arms is practically the same. The right axillary vein is a little tense.

Provocation test (2 minutes' work with clothes-brush) results in distinct venous stasis in the right arm, configuration of collateral pectoral veins, and a slight reddish-blue hue of the right hand.

Case 3. Female, 45 years old, draper. Reg. No. 943/42. Admitted $10/5$ — $27/5$ 42.

Past history of generally good health, but always tendency to coldness of the hands and erythema pernio in the winter.

Present Illness: One morning, 8 days before admission, the patient noticed suddenly that her left arm was swollen and bluish-red in color. During the following days the left arm and hand were swollen and there was a sensation of tension, but no real pain in the arm. She is not able to attribute the appearance of the symptom to any direct or indirect traumatic injury. In her work she daily has to lift rather heavy rolls of cloth from shelves and put them back again, but this work has not been more strenuous lately than previously. She has not felt feverish. She has no cold. There has been no wound or dermatitis on the arm or hand.

Physical Exam.: The left arm is the site of a diffuse oedematous, somewhat firm, swelling, extending from the hand up to the shoulder region, scapular region and clavicular region. The swelling is not so firm as in most cases of this syndrome. Thus, on the hand the swelling appears as oedema proper. When the arm is hanging down it has a cyanotic hue. The skin is a little warmer on the left than on the right side. In the left axilla the axillary vein feels a little tense and tender. No enlargement of the lymph glands. Venous configuration is seen in the left pectoral region and over the left shoulder. Circumference of the left upper arm and forearm respectively $6\frac{3}{4}$ and 3 cm. larger than the symmetrical measures on the right side. The radial arteries are alike on both sides. *Otherwise no abnormality.*

Urine normal. Temperature slightly elevated in the first week in the hospital, 37.1 — 37.4° in the mornings, 37.6 — 38° in the evenings. After this, normal. Hemoglobin percentage and complete blood count normal. Wassermann negative. Widal ($16/5$) negative. Blood culture ($16/5$) negative. Sedimentation rate ($11/5$ and $16/5$): 7 and 8 mm. Blood pressure normal. Electrocardiogram normal.

Venography (10 days after the onset of symptoms), Fig. 4: the basilic vein is uncovered through an incision, as the oedema makes percutaneous injection impracticable. Perabrodil is injected into the basilic vein. At the beginning of the axilla a large defect in the main vein is seen, surrounded by a highly developed collateral circulation. More proximally, coat-formed contrast substance in the axillary vein.

Course and Treatment. As this is a case of thrombosis (or thrombophlebitis) of the axillary vein and has lasted only a short time, expectation is decided on. Within one week the temperature decreases to a normal level. A great deal of oedema fluid flowed from the incision in the left cubitus in the days following venography, which made the oedema subside rapidly. The arm was placed on a slanting cushion. Then the patient was allowed to get up, with the arm in a sling. The

site of the incision was infected, and paresthesias appeared in the left forearm. The suppuration subsided rapidly, however. Then the patient was given light massage of the arm for 3 weeks.

Reexamination, 2 months later: No evident phenomena of stasis. Circumference of the left upper arm 1 cm. larger than that of the right arm; no difference between the forearms. The patient is instructed to keep the arm at rest for some time.

After 6 months she pays no particular attention to the arm, which still is liable to swelling on clothes-brushing and similar movements. She has been given Tabl. vasodil »Leo», 2×3 for several periods. At any rate this treatment has had a favorable effect on the erythema pernio. The neuritic symptoms (after the incision) persisted for a long time. She possibly improved somewhat by treatment with vitamin B.

Case 4. Female, 42 years old, customs officer. Reg. No. 2232/42. Admitted $14/10$ — $28/11$ 42.

Past history. 6—7 years ago, various nervous symptoms: shortness of breath, palpitation of the heart, nausea, weakness of both arms, flickering before the eyes. Since then, she gets overexerted and nervous easily. About 5 months ago she was treated in a massage clinic for myoses of the musculature of the shoulder, the treatment consisting in massage, suction and diathermy.

Present Illness: For a long time she has not been able to lie on her left shoulder without discomfort or even slight pain. Two weeks before admission the patient hit her left shoulder against a lamp-post. A few days before admission she probably strained her left arm by carrying a heavy sack of potatoes. On the day before she took ill she had been for a long walk with a convalescent whom she supported with her left arm. On the following morning the left arm was diffusely swollen and bluish. The patient noticed also a sensation of slight tension of the left hand. The swelling and cyanosis were aggravated when the patient was walking about with her arm "hanging down". She became afraid and consulted her physician who referred her to the hospital at once.

Physical Exam.: Diffuse, cyanotic, marmorate, bluish discoloration of the entire left upper extremity, most pronounced on the posterior aspect of the upper arm, where small phlebectases are seen. The pectoral veins are barely visible, and the same applies to the venous configuration in the left infrascapular region. There is slight tenderness of the left axilla, corresponding to the axillary vein. The circumference of the left upper arm is 1.3 cm. greater than the right; no definite difference between the forearms in this respect. *Otherwise no abnormality except that the temperature was subfebrile during the first two weeks in the hospital.* Since then, the temperature was practically normal.

Urine normal. Hemoglobin percentage and complete blood count normal. Wassermann negative. Sedimentation rate: 9, 14 and 8 mm. (on $15/10$, $3/11$ and $13/11$). Widal negative. Blood cultures (2 times): no growth. Blood pressure normal. Electrocardiogram normal.

X-Ray Exam.: No abnormality of the heart and lungs. No sign of

cervical rib. Slight sinistroconvex scoliosis of the upper part of the dorsal column.

Venography (about 4 weeks after the onset of symptoms), Fig. 5: Injection of 20 cc. of perabrodil into the left medial cubital vein gives good filling of the cephalic vein up to the area under the clavicle. The basilic vein is not filled with contrast substance; on the other hand, small amounts of contrast substance are found in the brachial veins, up to the level of the surgical neck of the humerus. No continuation to the axillary vein is seen here, whereas there is a massive contrast filling of the extensive collateral circulation round the scapula.

Course and Treatment. The clinical picture is suggestive of thrombosis (or thrombophlebitis?) of the axillary vein. As the symptoms have been present only for a short time, it is decided to try conservative treatment. The arm is placed on a slanting cushion. Venography supports the clinical diagnosis strongly. In order, if possible, to promote the healing process, 2 weeks after admission the patient is given heparin 100 mg. \times 3 daily for 6 successive days. But the clotting time is increased only to 7 min. Under this treatment she feels distinct relief from the discomfort of the arm, and the temperature becomes normal. As the arm keeps being swollen and bluish also after the patient is allowed to get up, she is given light massage. The arm soon becomes almost normal.

Reexamination, two months later: The left arm is still somewhat marmorate and the site of various abnormal sensations. Provocation test (clothes-brushing for 2 min.) produces an increase in the cyanosis and marmoration of the arm, besides a slightly firmer consistence. But the stasis is far less pronounced than previously.

Case 5. Male, 26 years old, stockroom clerk. Reg. No. 571/43 Admitted $\frac{3}{3}$ — $\frac{20}{3}$ 43.

Past history: Good health except for a pronounced tendency to angina with peritonsillar abscess formation — which he has had 10 times, last time 4 years ago.

Present Illness: About one month ago he noticed a sensation of heaviness of the muscles of the right arm and tension of the entire right arm. He continued working however, and about 10 days later he had a slight gnawing pain in the arm, and this pain subsided when he carried the arm in a sling.

His work consists, among other things, in lifting heavy rolls of steel cable, weighing up to 100 kg. and putting them on the counter. Lately, before the onset of his present lesion, he had been sawing a good deal of wood. He has not felt feverish, nor has he had any sore throat lately.

Physical Exam.: The entire right upper extremity is diffusely swollen; its consistence is dough-like, without any oedema proper. The swelling extends over the right deltoid, infraclavicular and scapular region. The skin is slightly cyanotic, especially on the right hand and forearm. There is no definite difference in the temperature on the two sides. Distinctly increased venous configuration, especially on the anterior aspect of the right upper arm. Distinct collateral venous configuration

in the right pectoral and acromial regions. A cord as thick as a little finger, not tender, is palpable in the right axilla. The circumferences of the right upper arm and forearm are increased respectively by 5 and 3.5 cm. as compared to the symmetrical measures on the left side. *Otherwise no abnormality* beyond redness of the mucous membrane of the throat and slight enlargement of the right tonsil.

Temperature normal, urine normal. Hemoglobin percentage and complete blood count normal. Wassermann negative. Sedimentation rate: 17, 10 and 9 mm. (on $\frac{5}{3}$, $\frac{8}{3}$ and $\frac{18}{3}$). Widal negative. Blood culture: no growth. Antistreptolysin titer slightly increased: 230 \rightarrow 250 \rightarrow 200. Blood pressure normal. Electrocardiogram normal.

X-ray Exam.: No abnormality of the heart, blood vessels and lungs. No evidence of a cervical rib.

Venography (about 1 month after the onset of symptoms), Fig. 6: Injection of perabrodil into the basilic vein. The veins are seen to be thrombosed even on the middle of the arm, no contrast substance entering the axillary vein or its tributaries in the upper half of the upper arm. The contrast substance injected flows back and enters the cephalic vein, which presents itself as a very thick venous trunk.

Venous Pressure (at rest, with slight elevation of the trunk of the patient). Right upper extrem.: 30 cm. H_2O .

Left " " 10—15 cm. H_2O .

Course and Treatment. As the thrombosis is judged to have consisted for a considerable length of time, presumably with commencing organization, there is not found to be any indication for heparin therapy. Performance of venous resection for shortening of the course of the lesion is taken under consideration; but this is desisted from as the swelling of the arm subsides rather considerably within a brief period.

The patient keeps the arm at rest the first 6 weeks and then he resumes his work, though avoiding any hard exertion.

Reexamination, about 2 months after his discharge: There is still some diffuse swelling and venous stasis of the right upper extremity, and the right upper arm is still 4.3 cm. larger in circumference than the left. Provocation test (2 min. clothes-brushing) results in typical venous stasis of the right arm. The tissue becomes typically firm, with doughy-like swelling and cyanotic hue. After pressing and elevation of the arm, the stasis subsides immediately. The patient is directed to avoid any strenuous work with the arm.

Case 6. Male, 23 years old, polytechnical student. Reg. No. 981/43. Admitted $\frac{8}{4}$ — $\frac{11}{5}$ 43.

Past History: Good health. He is a trained mechanic; very muscular.

Present Illness: After playing basket ball, 6 days ago, he has noticed a marked tiredness and increasing swelling of the right arm; and in the last few days there has been slight pain in the arm too. He has the bad habit of tearing his finger-nails, on which account he often has inflammatory processes at the margins of the nails — without paying any particular attention to them. He has not had any infectious disease recently. He has not felt feverish.

Physical Exam.: Considerable doughy-like firm swelling of the entire right upper extremity, which has a slight cyanotic hue, especially on the dorsal aspect of the hand. The infiltration is localized especially to the medial and flexor aspects of the arm. The subcutaneous veins are very conspicuous on the right arm and in the right pectoral region. The anastomosis with the subcutaneous veins of the neck is seen distinctly. Fine phlebectases are seen on the anterior surface of the arm. On palpation, the axillary vein feels as thick as a little finger, tense, not tender. The right hand feels a little cooler than the left. No abnormality of the joints. No disturbance of the sensibility. The muscular power is not lowered. The circumferences of the upper arm and forearm are respectively 8 and 5 cm. larger than the corresponding symmetrical measures of the left side. *Otherwise no abnormality.*

Temperature, on admission, normal. Urine normal. Hemoglobin percentage and complete blood count normal. Wassermann negative. Sedimentation rate ($^{\circ}/_4$): 15 mm. Widal negative. Blood culture $^{12}/_4$: No growth. Antistreptolysin titer normal. Blood pressure normal. Electrocardiogram normal.

X-ray Exam.: No abnormalities of the heart and lungs.

Venography (10 days after the onset of symptoms), Fig. 7: Injection of perabrodil forte into the right median cubital vein. Marked filling of the cephalic vein, which is considerably broader and more dilated than normally; besides, on the upper arm, a small and somewhat tortuous, probably deep, vein is seen to fill whereas there is no filling of the basilic vein. Just laterally to the 2' and 3' ribs a 1 cm. wide, very poorly filled, vein is seen; laterally this vein can be followed out to the deep vein; medially it is directed upwards and towards the mid-line; its location corresponds very well to that of the axillary vein. Further, above, in the infraclavicular fossa, a well-developed collateral circulation is seen. It seems reasonable to assume that this is an instance of thrombus formation in the axillary vein, with secondary dilatation of the cephalic vein and development of a collateral circulation round the latter.

Course and Treatment. After the venography the swelling of the right arm increased quite considerably. In addition to the firm swelling described there now appeared a condition of oedema proper too, which was particularly pronounced round the olecranon. There was also swelling of the supra- and infrascapular regions. A tender venous trunk was palpable in the axilla, and the tenderness continued down in the right arm. The development of these phenomena was associated with aching and spastic sensations in the arm, so the patient had difficulty to keep his arm at rest in bed, even with employment of a slanting cushion. During these days the temperature was subfebrile.

As evidently this phase of the lesion involved a fresh attack of phlebitis, heparin therapy was instituted, on $^{14}/_4$, with 100 mg. of heparin \times 3 daily. After 2 days the patient had chills, and also his general condition was affected. The temperature rose to 40.2° , whereafter it kept oscillating round 39° for the next 9 days. After 1 week the heparin treatment was discontinued. Under this treatment the

swelling of the arm subsided strikingly. On the day after the discontinuance of the treatment the patient presented signs of infarction of the right lung. He was given morphin, besides lucosil (sulfamethylozole) in pneumonic doses for 5 days. Under this treatment the temperature fell to a subfebrile level, at which it kept for one week, and then it became quite normal. At his discharge from the hospital the difference in circumference of the two arms was only 2—3 cm. There was still a slight increase in the consistence of the right arm and moderate prominence of the venous configuration. The right axillary vein was no longer tender on palpation, and it was only as thick as a pencil. At his discharge he was directed to save the arm from any strenuous work.

Reexamination, 4 months after discharge: He has kept the arm at rest until 1 week ago when he tried to saw some wood. This work was immediately followed by an increased tightening and slight swelling of the arm. The circumferences of the right upper arm and forearm are respectively 3.5 and 2.7 cm. bigger than the corresponding measures of the left side. He is directed to keep the arm at relative rest.

Case 7. Male, 32 years old, office clerk. Reg. No. 2420/43. Admitted $24/11-7/12$ 43.

Past History: Previously he has been troubled a good deal with boils, among other places at the anus, for which an incision was made in 1942. He has been vaccinated against furunculosis. Otherwise good health. He has previously done a lot of gymnastics, but not the last couple of years.

Present Illness: A few months ago he took up gymnastics again (Niels Bukh). 5 days before admission his partner was particularly energetic with a certain exercise, and this gave rise to the development of the lesion for which he now is admitted. This exercise consisted in that the partner placed his knee on the back of the patient and "rotated" his arm extremely in the shoulder joint in all directions, accentuating in particular the abduction. At that point of time the patient had a cold with eruption of herpes on the lip, but he did not feel feverish. Since this gymnastic overexertion the patient has noticed that his right hand has become bluish, and the blood vessels on the right hand and arm have become conspicuous. Now there is also tightness in the right axilla and slight pain in the elbow on full extension of the arm.

Physical Exam.: Slight diffuse swelling of the right upper extremity, but the consistence is not doughy. Very pronounced venous configuration with tortuous veins on the anterior surface of the right upper arm, continuing over in the pectoral region. In the right axilla a barely tender, elongated, structure, about the thickness of a little finger, is palpable, presumably the vein. A pea-sized lymph gland is felt in the right axilla, and the lentil-sized cubital lymph gland in the right arm. The right hand is a little reddish in color. The muscular power is lowered on the right side. No distinct difference in the skin temperature in the two sides. Circumferences of the right upper arm and forearm respectively 4.5 and 2 cm. larger than the symmetrical measures of the left side.

Otherwise the examination shows: The patient is rather thin, slightly catarrhal. Auscultation reveals fine crepitating râles below in the left infrascapular region. Heart sounds normal. Typical respiratory arrhythmia.

During the first 6 days after admission the temperature was subfebrile (about 37.6°). Later it was normal (under 37°).

Urine normal. Hemoglobin percentage and complete blood count normal. Wassermann negative. Sedimentation rate, $^{26}_{11}$ and $^{6}_{12}$: 14 and 5 mm. Blood culture: No growth. Antistreptolysin titer normal. Blood pressure normal. Electrocardiogram normal.

X-ray Exam.: No abnormality of the heart and lungs. No sign of any cervical rib.

Venography (2 weeks after the onset of symptoms), Fig. 8: Injection of 18 cc. of perabrodil into a superficial vein on the radial-volar aspect of the upper part of the forearm, in the direction of the middle of the cubital fold, where the vein appears to go down in the depth. Good filling is seen of the vein directed towards the medial side of the upper arm but this venous configuration is interrupted suddenly, 3—4 fingers' breadth over the elbow-joint. From this vein the contrast substance passes through 2 medium-sized superficial veins on the lateral side of the arm to the cephalic vein, which can be followed up to the middle of the clavicle. In addition there is abundant contrast filling of a dense venous plexus round the scapula. There is no filling of the basilic vein, nor of the deep brachial veins or the axillary vein. The sudden interruption of the filling in the injected vein described above is suggestive of complete thrombosis of this vein.

Course and Treatment. This was an instance of fresh thrombosis of the veins of the right upper arm. As the complaints were few and slight, an expectative treatment was adopted. The arm was placed on a slanting cushion. The temperature became normal as the catarrhal symptoms subsided. Venography was not followed by any inconvenience; and the swelling of the arm subsided rapidly after the patient got up. He was discharged with directions about saving the arm from any strenuous exercise for a while.

Reexamination, about 2 months later: Since his discharge he has had several small boils which have been incised. Now he is vaccinated with autovaccine. He has also had an attack presumably of Quincke's oedema. Now the circumferences of the right upper arm and forearm are respectively only 2.5 and 2 cm. larger than the corresponding measures of the left arm.

Discussion.

The cases here reported are all good examples of the syndrome mentioned in the introduction. The clinical features of the lesion are so typical that this condition hardly may be mistaken for any other lesion. The venous stasis is the essential feature in this

picture. The venous pressure has been measured but occasionally, and in those cases (Nos. 1, 5 and 7) the values obtained have been in keeping with those reported previously: at rest and, especially, during attacks (provoked by work with the arm) the



Fig. 1. Case 7. Photo with infra-red rays.

venous pressure is markedly increased. A good illustration of the venous stasis is found in photos taken with infra-red rays (see Fig. 1).

In looking for the cause of this venous stasis, like previously, we are able at once to exclude the possibility of any extravascular mechanical obstruction to the venous flow — as, for instance, the presence of a tumor in the axilla or intrathoracic tumor formation. Once, in another hospital, I have seen such a case where enlargement of mediastinal lymph glands (due to lymphogranulomatosis) was the cause of a moderate degree of venous stasis that first was taken to signify thrombosis of the axillary vein.

From the venographic findings the lesion appears in all these cases to have been a thrombus formation in the axillary vein. All the patients presented a more or less extensive filling defect in the axillary vein (or brachial veins) and all the patients except No. 5 presented a pronounced configuration of the collateral venous network (see Figs. 2—8).

But the question arises: Can it be taken for granted that the venographic changes here described really signify thrombosis or thrombophlebitis? It will be reasonable primarily to refer to the general experiences from venographic examination of the veins of the lower extremities (BAUER) and, especially, the experiences gained as to venography of the venous trunks of the upper extremity (KAPLAN & KATZ; VEAL; ANDERSEN). The picture characteristic of thrombosis implies just a very pronounced collateral venous configuration together with the possible occurrence of a break or defect in the venous shadow. The real proof of such a venographic picture involving just a thrombosis or thrombophlebitis is found in our patient No. 1, in whom the operation revealed the presence of thrombosis of the axillary vein. On the other hand, LÖHR has emphasized strongly that the presence of thrombosis is not absolutely necessary to produce a strong collateral venous configuration. He thinks that very often it merely is the presence of perivascular constricting processes round the vein that is able to produce the venous stasis and the collateral venous configuration associated herewith. Whether such processes also may be able in venography to give defects in the outline of the venous trunk in the same massive way as seen in the present cases, seems very doubtful.

If now we compare the present venographic findings with the ones reported in my previous paper, it is to be pointed out first that all the present patients except for No. 1 were examined venographically in direct connection with the appearance of the symptoms or, at any rate shortly (from a couple of days to one month) after the onset, whereas it was different with the three venographed patients in my first report. Of them, No. 1 was venographed about 2 years after the appearance of the syndrome, No. 2 about 2 months after; only No. 5 was venographed as early as 3 weeks after the onset of the lesion. None of these patients showed venographic signs of thrombosis. This may possibly be explainable — at any rate as far as No. 1 is concerned, and perhaps for No. 2 too — as attributable to the circumstance that at the time of their examination these patients no longer presented any thrombosis or thrombophlebitis but merely the sequelæ of this, namely: the typical provokable stasis syndrome which, as suggested by VEAL, is designated as the *post-thrombotic syndrome*. If so, we would be dealing with a true thrombotic process which had undergone organization and re-



Fig. 2. Case 1. Venography. Filling defect (corresponding to the arrow) at the axilla. Pronounced filling of deep collaterals.



Fig. 3. Case 2. Venography on the 6th day of illness. Partial coat-formed filling of the brachial and axillary veins. One brachial vein is completely occluded.



Fig. 4. Case 3. Venography. Large defect in the main vein (corresponding to a V-shaped mark), surrounded by pronounced collateral venous configuration. More proximally, coat-formed contrast substance in the axillary vein.



Fig. 5. Case 4. Venography. The axillary vein is not filled. The cephalic vein is markedly filled. In addition, pronounced collateral venous configuration.



Fig. 6. Case 5. Venography. Brachial veins interrupted on the middle of the arm. Cephalic vein markedly filled. Scanty collateral venous configuration.

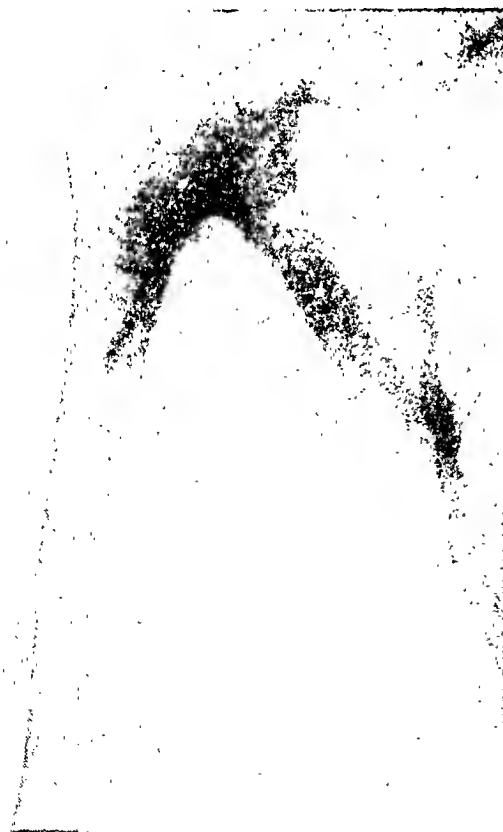


Fig. 7. Case 6. Venography. Only a small part of the axillary vein is seen, situated between the arrows, poorly filled with contrast substance. Cephalic vein markedly filled. Several collaterals.



Fig. 8. Case 7. Complete absence of filling of the basilic, brachial and axillary veins. Abundant collateral venous configuration. Cephalic vein distinctly filled.

canalization, leaving merely some minor changes in the wall of the vein that were not palpable at the operation, nor able to give the characteristic venographic picture. The explanation of the entire clinical picture presented by these two patients¹ might then be looked for in spastic phenomena in the main venous stem and in the collaterals, brought about by the sequelæ of a previous thrombophlebitic process. In the third of the venographic cases reported the morbid features presented by the patient were so slight and abortive that the negative venography needs no further discussion.

Another explanation of the stasis syndrome in the previous cases where the patients presented no venographic signs of thrombosis may be found, as mentioned previously, in irritative factors influencing the vein (owing to particular anatomical difficulties in the passage of the venous flow), which again results in spastic phenomena in the main trunk and its collaterals.

As a third possibility for explanation of the stasis syndrome in these previous cases it might be mentioned that *perhaps* there may have been thrombosis of the subclavian vein. I have been told that such a case was observed recently and the patient treated operatively in the Surgical Out-patient Department of the Rigshospital (Professor E. HUSFELT), wherefrom the case will be reported. Thrombosis of this kind cannot be verified roentgenographically. In one of my earlier venographed patients (No. 1), this possibility may be excluded, as at the operation the subclavian vein did not show any sign of thrombosis. The operation, however, was first performed 2 years after the onset of the symptoms.

Returning to the present cases and considering their entirely clinical picture, we find also here certain features differing from those reported previously. Thus, 3 of these patients (Nos. 3, 4 and 7 showed a quite slight elevation of the temperature, and in 4 out of 7 the sedimentation rate was slightly elevated or at the border of the normal value (Nos. 2, 5, 6 and 7).

In the cases previously reported the temperature and sedimentation rate were quite normal. This is explained by the circumstance that in nearly all our previous cases the lesion was of a relatively old date, representing what VEAL has designated

¹ Another case, not published previously, may have been explainable in exactly the same manner. In this case venography was not performed till 2 years after the onset of symptoms.

as the post-thrombotic syndrome, while in nearly all the present cases the lesion was of recent origin.

In my previous work I considered the thrombosis a complication. But, after studying the present series of cases, with thrombosis present in every instance, I am inclined to think that thrombus formation is the general phenomenon of this syndrome even though such a process may not be stated to be a *conditio sine qua non* for the appearance of the syndrome.

Considering the pathogenetic factors that may be deduced from the present case histories, they do not appear to differ particularly from those mentioned previously. In all the present cases there has been a certain possibility of indirect traumatic injury to the arm through the performance of strenuous muscular work. From the available data, however, it is not practicable to establish any definite mechanism of traumatism — which presumably is of individual nature. Still, it seems reasonable now to take it for granted that in most cases the axillary (subclavian) vein is injured in some way or other. As to a more thorough discussion of the various theories of traumatism, the reader is referred to my previous paper. The abduction trauma emphasized in particular by VEAL (1940) and by NEIJ (1943) — by which the axillary vein is compressed against the subscapularis muscle under the head of the humerus — seems evident only in one of the cases (No. 7), in which particularly thorough information was obtained about the mechanism of the traumatic injury. Of course, abduction trauma may very well have been an effective factor in other cases too.

In all the cases the general condition of the patient has been good. No sign of any disease of the blood was observed in any instance. Apparently infectious diseases have not occurred immediately before or simultaneously with the development of the venous stasis. In 2 cases, however — Nos. 5 and 7 — the patients give a history respectively of chronic tonsillitis (with acute exacerbation?) and sore throat with slight bronchitis and with latent furunculosis. But in these two cases there appears to be no reason to assign any pathogenetic significance to the slight infection mentioned. Infection of wounds on the hand or arm — the significance of which has been emphasized in particular by BIEBL — has not occurred in any of our patients, not even in No. 6, in whom there was a certain chance of the occurrence of this condition.

cases — of thrombosis or thrombophlebitis localized to the lower extremities.

As to the indication of venography in these cases, it will be appropriate here to remark that naturally the clinician will always aim to make the exact diagnosis as early as possible, but — as far as practicable — without means that may be injurious to the patient. In 2 of the present cases (Nos. 2 and 6), however, one gets the impression that the swelling of the arm was aggravated distinctly after the venography, which was performed for scientific reasons. In both cases the venography was performed very early after the appearance of the symptoms. In Case 2, moreover, the axillary vein was submitted to a particularly hard tolerance test as, shortly after the first attempt at venography, a new injection of contrast substance was given in the direction of the basilic vein, notwithstanding considerable resistance. But this was not the case in patient No. 6. We cannot, I think, quite exclude the possibility that besides the preexisting thrombosis the employment of venography may have occasioned a chemical phlebitis which in turn has accentuated the preexisting stasis causing a marked increase in the oedema of the arm. In such cases an early venography appears not to be so harmless as suggested by the literature (BAUER and others) on the employment of this measure in phlebitis of the lower extremities. Now, however, the syndrome of stasis of the upper extremity here described appears so characteristic in its clinical manifestation and requires no particular operative treatment in its acute stage, so that in the future it will hardly be necessary to perform venography on these patients at the commencement of the lesion.

Summary.

Description is given of 7 cases of acute onset of venous stasis of the upper extremity produced by thrombosis of the axillary vein. In all the cases the presence of thrombosis was verified by venography — and in one case by operation too. In all the cases the history of the patient implied the possibility of indirect traumatic injury to the axillary (or subclavian) vein.

All the patients were young persons with a past history of good health.

Comparison is made of these cases with similar cases reported

previously by the writer under the designation "so-called traumatic thrombosis of the axillary (subclavian) vein", in which no sign of thrombosis was disclosed by venography or operation. Attention is called to the possibility that these previous cases may have represented sequelæ after thrombosis (VEAL's "post-thrombotic syndrome").

In the future we have to reckon with the possibility of thrombosis in patients presenting the syndrome to a far greater extent than stated by the writer previously — and also far more often than indicated by the frequency with which the presence of thrombosis has been verified in the cases reported by other authors.

An account is given of the treatment, which ought not to be operative; presumably it ought to consist in suitable mobilization of the extremity involved rather than immobilization — in keeping with the more recent experiences in cases of thrombosis and phlebitis of the lower extremities. Only in protracted cases of stasis with repeated relapses is operative treatment (venous resection) to be taken into consideration. In the acute stage of the lesion, presumably, venography is apt to aggravate the stasis and oedema, and hence it is inadvisable.

Zusammenfassung.

Es werden 7 Fälle von akut aufgetretener Venenstauung in der oberen Extremität, bedingt durch Thrombose der Vena axillaris, beschrieben. Die Thrombose wurde in sämtlichen Fällen durch Venographie bestätigt, in einem Falle auch durch die Operation. In sämtlichen Fällen liegt die Möglichkeit indirekter Traumatisierung der Vena axillaris, evtl. der Vena subclavia, vor. Sämtliche Patienten waren gesunde Menschen in jüngerem Alter ohne voraufgehende Krankheit. Die Fälle werden mit ähnlichen Fällen verglichen, die schon früher von Verf. unter dem Namen der sog. traumatischen Thrombose der Vena axillaris (subclavia) veröffentlicht wurden, und wo bei Venographie oder Operation keine Anzeichen von Thrombose gefunden wurden. Es wird darauf aufmerksam gemacht, dass diese früher veröffentlichten Fälle Folgen einer Thrombose (VEAL's post-thrombotisches Syndrom) dargestellt haben können. Man wird bei dieser Krankheit in Zukunft in weit höherem Grade mit der Möglichkeit einer Thrombose

rechnen müssen, als was Verf.s früheren Angaben und der Häufigkeit bestätigter Thrombosen im Schrifttum entspricht.

Die Behandlung wird beschrieben; sie soll nicht-operativ sein und nach Verf. in geeigneter Mobilisierung, statt in Ruhigstellung, bestehen, ganz in Übereinstimmung mit den neueren Erfahrungen bei Thrombose und Phlebitis der unteren Extremität. Eventuelle Operation (Venenresektion) nur bei langwierigen, immer wieder rezidivierenden Fällen von Stauung. Venographie im akuten Stadium soll die Stauung und das Ödem verschlimmern können und wird abgelehnt.

Résumé.

Description de sept cas de stase veineuse, à début brusque, de l'extrémité supérieure, causée par une thrombose de la veine axillaire. Dans tous, la réalité de la thrombose a été établie par la veinographie, et dans l'un également par l'opération. Chaque fois existait la possibilité d'un traumatisme indirect de la veine axillaire ou éventuellement de la sous-clavière. Tous ces patients étaient des sujets jeunes et sains, sans antécédents pathologiques. Ces cas sont comparés à d'autres, semblables, que l'auteur a publiés antérieurement sous la désignation de «soi-disant thrombose traumatique de la veine axillaire (sous clavière)» et où ni la veinographie ni l'opération ne permirent de découvrir des signes de thrombose. L'auteur rend attentif au fait que les cas en question, publiés jadis, peuvent avoir représenté les séquelles d'une thrombose (le syndrome post thrombosique de VEAL). A l'avenir, dans cette maladie, il faudra compter avec la possibilité d'une thrombose dans une beaucoup plus large mesure que l'auteur ne l'avait dit précédemment, ou que cela ne semble ressortir du nombre des thromboses vérifiées qui sont rapportées dans la bibliographie.

L'auteur parle du traitement qui doit être conservateur et consister, à son avis, en mobilisation adéquate plutôt qu'en immobilisation, conformément aux expériences récentes faites dans les thromboses et phlébites des membres inférieurs. L'opération n'est que rarement indiquée (résection de la veine), et cela dans des cas de stase de longue durée et récidivant sans cesse. La veinographie au stade aigu peut vraisemblablement aggraver la stase et l'œdème et est à déconseiller.

References.

(For a more general list of literature the reader is referred to my previous paper.)

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From the Surgical Department of Kronprinsessan Lovisas Barn-
sjukhus, Stockholm.
(Head: Dr. JAMES HINDMARSH.)

Femoral Fractures in Children.

Some Viewpoints on their Prognosis and Treatment.

By

ERIK HEDBERG.

It is a well known fact that femoral fractures in children are distinguishable from fractures in adults not least by their much more favourable prognosis. On the basis of the good results obtained, now one, now the other method of treatment has been claimed as ideal. However, the explanation is doubtless to be looked for rather in the great capacity of the young organism to repair, correct, and compensate even fairly serious faulty positions, than to the reliability of the various methods employed. Nevertheless, this circumstance does not justify complete faith in the healing power of nature alone. On the contrary, as far as children are concerned, there is no reason to abandon that fundamental principle of the science of fractures, which has been best expressed in the words of the British Research Committee of the year 1911: Notwithstanding the good functional result of any anatomical issue, the safest way of obtaining satisfactory mobility is, nevertheless, to secure an adequate anatomical position in the fracture.

The *application of plaster*, with or without previous reduction, has increasingly lost its significance as method of treatment of femoral fractures. However, it is still employed in combination with direct extension or surgical treatment. Yet, the method as such does not lack advocates. Thus, YOVCHITCH gives an account of 88 cases, all with good results, treated mainly with reduction and plaster. The method has been recommended by CAMPBELL, FIROR, among others.

The opponents of the method concentrate their criticism above all on the ineffectiveness of the plaster cast in producing the required fixation in a chiefly longitudinal direction through the thick layers of soft tissue in the femur. SPEED writes in this connection: "It is practically impossible to maintain any real extension in the longitudinal axis of the leg by means of plaster of Paris body cast." LEVANDER reports a number of cases where a deviation of the fragments has taken place in the plaster cast in spite of previous exact surgical reduction. The advantage of this method may, possibly, lie in the shortened stay at a hospital since the child may be treated at home without much inconvenience after the application of the plaster.

The most usual method employed nowadays is, without doubt, the *extension treatment*, whether the indirect method with adhesive plaster, or the direct one with wire traction. The extension treatment has come into general use and gained widespread acknowledgement. A great number of publications with good results throughout bear evidence of this fact. On the other hand, opinions differ considerably regarding the choice of the direct or indirect extension treatment.

Adhesive traction, as originally applied according to BARDENHEUER with adhesive strips along the whole femur, has been found, in tests performed by DUMPERT and FLICK, to lack even the theoretical prerequisites of producing satisfactory extension. More favourable results may be obtained when the adhesive plaster is made to end distally of the fracture. However, also in this case the effect of the extension is very limited. Accordingly, the adhesive traction may be employed successfully only in individuals with but slight development of the musculature, viz., in the very youngest children. The appropriate age limit has formed the subject of much discussion. Thus, WALDENSTRÖM uses adhesive traction in children up to an age of 12 years, COLE and NYLANDER up to 10 years, the latter employing vertical suspension up to and including 6 years of age and then a semi-flexion position. LEVANDER, as well as BURDICK and SIRIS, fix the limit at 6 years, WIEDENHORN and FALLER at 5, and DEMEL at 4. In the latter instances, vertical suspension is applied, either to both legs, or only to one. When only one leg is suspended vertically, the extension capacity is said to increase by 25—33 per cent (BURDICK and SIRIS).

The fact that adhesive traction is still employed to such a great extent also in children up to the age of 10—12 years is

doubtlessly, not due to its extension capacity but, instead, to the fully satisfactory result obtained in the majority of cases even without an exact anatomical position in the fracture. On the other hand, when an exact anatomical position is aimed at in a fracture with an obvious shortening of the leg, the age limit with regard to the usefulness of adhesive traction must, no doubt, be lowered considerably, probably to no higher than 4—5 years of age.

Apart from its slight extension capacity, adhesive traction involves another distinct disadvantage, viz., a child's sensitive skin may often become irritated by the adhesive plaster and rather ugly eczematous changes may appear owing to it, which may render impracticable a later, possibly indispensable, surgical reduction.

Direct extension with a nail or with wire traction applied on children has gained far less support than the indirect method. Direct extension was recommended by BARROS-LIMA who published a material of 54 cases, 52 of which showed good results. Also WIEDHOF emphasizes the superiority of direct extension as compared to indirect extension. He finds the latter method unsatisfactory, and considers it to entail risks of complications, such as rotation in the fracture and pes equino-varus.

Those opposing the use of the direct method turn, in particular, against the complications which are liable to arise. Lesions of the epiphysis are regarded as the most significant complications, since they may cause disturbances in growth and joint troubles (VON BRÜGGE). LEVANDER gives a description of such a case which disclosed, at an after-examination, a remaining shortening of the fractured leg of 6.2 cm. However, the risk of this complication is, no doubt, somewhat exaggerated, provided it is borne in mind during the application of traction and, furthermore, that this is placed sufficiently far from the border of the epiphysis.

Another drawback, inherent in this method, lies in the risk of osteitis and osteomyelitis (acc. BIEBL in 1.2 per cent). This complication is assuredly not more common in children than in adults with regard to this method and may, in all probability, as above be avoided in the majority of cases by observing all the necessary measures of precaution.

The above-mentioned disadvantages of the direct method are altogether counterbalanced by its obvious good points. The traction may be very easily applied during a brief narcosis. When the traction has been applied, the treatment is painless and the children

get on well with it. Furthermore, during the process of extension the children can be tended without difficulty and their skin is within easy reach in all parts. Moreover, the reduction may be controlled far better than in the case of indirect extension. The progress of the reduction may be followed without trouble by means of Roentgen, extension may be increased or decreased, as the case may be, and lateral traction may be applied when found necessary. The extension treatment may, possibly, be supplemented by plaster of Paris with maintained traction, which is also to be regarded as an advantage. The extension treatment may, in addition, be employed as a preparatory and supplementary procedure to surgical treatment when this is called for. Thus, direct extension must be looked upon as the ideal method of treatment also in children as soon as the musculature has reached the point of development when indirect extension is incapable of replacing the dislocation of the fracture.

Finally, as regards younger children, the difficulty of producing at all satisfactory extension treatment may be mentioned. This form of treatment is based, in the majority of cases, on the effect of two forces counteracting one another, i.e. the weight of the body and the weight which is applied to the traction. This effect is, of course, greatly diminished in the case of younger children owing to their inconsiderable body weight. Thus, a more pronounced shortening of the leg in a fracture may often be found hard to correct by means of extension treatment at this age.

The *surgical treatment* of femoral fractures in children, without doubt, forms the subject of the most conflicting opinions, whether surgical reduction only is concerned, or fixation with foreign material as well. The most common attitude is that operation is unnecessary with but rare exceptions. However, other viewpoints are also met with. In absolute opposition to the surgical therapy, EIKENBARY and LECOCQ state that they are convinced that 90 per cent of all fractures in children which had been operated upon would have united better without the surgical intervention. On the contrary, CHALIER, for instance, operated all femoral fractures systematically. Also BACKER-GRÖNDAHL used operation as the regular method when non-surgical reduction failed to produce the desired result within a short time.

Those opposing this method disapprove of operation as an unnecessary and risky procedure, basing their conception on the good results obtained by means of conservative therapy. The risks

entailed with regard to operation are, *inter alia*, prolonged union, pseudarthrosis, infection, etc. This criticism was rejected by BACKER-GRÖNDAHL after a comparative investigation between surgical and non-surgical cases. He arrived at the following results: In surgical treatment, union is prolonged which may be explained owing to the fact that only the most severe cases are operated upon. A more pronounced risk of pseudarthrosis or infection has not been ascertained, even in complicated fractures, provided they have been operated upon in good time. Nor does the fixation material, apparently, cause any marked inconvenience.

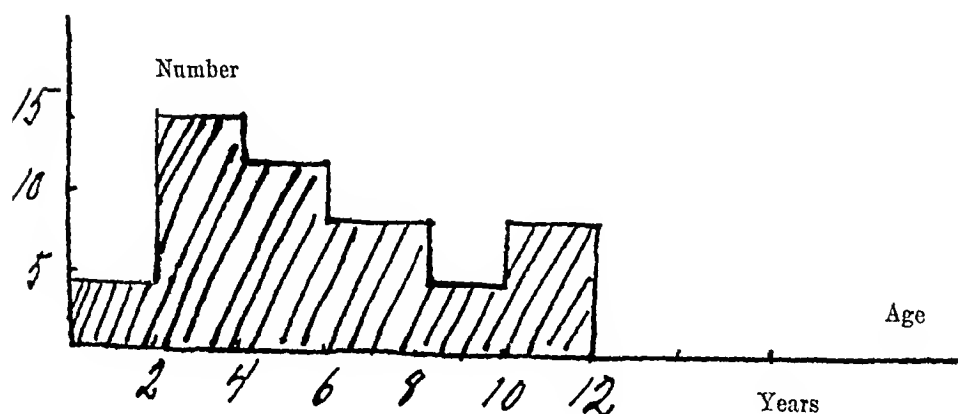
To this may be added that surgical therapy has, undoubtedly, many positive advantages. Surgical treatment is the surest way of obtaining an exact anatomical position in the fracture and, consequently, constitutes the best prerequisite of a fully satisfactory result from the point of view of function. CHALIER points out that the trauma causing the fracture often gives rise to an extensive laceration of the musculature with interposition of soft tissue parts and the accompanying risk of pseudarthrosis. Surgical treatment finds further support in the fact that the consolidation in the fracture sets in much more rapidly in children than in adults, and there is often no time to correct the faulty position by means of conservative therapy before it has become definite. Thus, it is more expedient to operate early than to bring the conservative therapy to a head and, accordingly, fail to benefit from the favourable occasion for surgical intervention. This has been emphasized also by WIEDENHORN and FALLER who caution against the results of such treatment in the shape of prolonged and disturbed callus formation owing to repeated non-surgical attempts at reduction with over-tension of the muscles and the periosteum. When conservative therapy fails to give the desired result, operation should be performed most suitably on the eighteenth day.

The surgical methods employed have, broadly speaking, been the same as those used in femoral fractures in adults. Either surgical reduction combined with plaster of Paris only has had to suffice, or a fixation material has been added, such as cerclage, osteo-suture, os purum, Lane's plate, etc. In oppositional quarters, attention has frequently been drawn to the injurious effect on the growing organism of the fixation material in its capacity of a foreign body. Thus, OMBRÉDANNE warns emphatically against the use of foreign osteo-synthetic material in children. According to WIEDENHORN and FALLER, Lane's plate may easily give rise to

osteomyelitis and sequestration, while cerclage with wires does not involve any trouble. YOVCHITCH and ALGRAVE, on the other hand, principally employ a plate and consider themselves to have obtained good results by means of it. NYLANDER describes a case of femoral atrophy after the use of cerclage. On the whole, it may be agreed that the young organism tolerates foreign osteo-synthetic material just as well as adults. In the majority of published cases, surgical intervention has been combined with a plaster of Paris treatment or direct extension, the advantages of which are, probably, by now well known as supplementary treatment.

The material in the present paper is derived from the Surgical Department of Kronprinsessan Lovisas Barnsjukhus and comprises the patients treated at this department for femoral fractures during the years 1937—1941. All these patients have been subjected to after-examination during the spring 1943, with the exception of one settled abroad. Only cases where a fracture with dislocation has been confirmed by Roentgen have been included, i.e. not simple fissures and infractions. Furthermore, fractures in a previously pathologically changed leg have been omitted. Thus, the after-examination has comprised altogether 44 cases. All the fractures have been uncomplicated and unilateral.

All the patients are of the age of 1—12 years. The exact age distribution will be seen in the curve below:



As regards the distribution between the two sexes, the male sex shows a marked predominance, viz., 72 per cent (34 boys and 10 girls). This figure is well in agreement with the corresponding value given by LEVANDER and CARLSSON, viz., 79 and 80 per cent, respectively. This condition may, probably, be explained by the fact that boys are more inclined to sports and dangerous games.

In describing the character and localization of the fractures, the same nomenclature is employed in the present paper as that of CARLSSON and, later, LEVANDER. The appearance of the material when translated into this nomenclature will be seen as follows:

Form	Localization			Total
	Upper third part	Middle third part	Lower third part	
Transverse fracture	1	7	2	10
Oblique fracture	3	16	2	21
Spiral fracture	2	10	—	12
Splinter fracture	—	1	—	1
	6	34	4	44

23 of the fractures have been localized to the left leg and 21 to the right leg.

As regards the circumstances which were the cause of the accident, the following distribution is made:

During play (in a wide sense)	27
Traffic accidents	9
Ski-running	7
Tobogganing	1

Among the traffic accidents, 8 are due to motor cars and only one to a bicycle. As regards different sports, ski-running appears to be most risky from the point of view of accidents.

The methods of treatment have been those in common use, viz., plaster of Paris, direct and indirect extension, and surgical treatment. In several cases a number of methods have been employed in one and the same instance, frequently in combination with one another. In order to gain a survey of the most important data concerning the kind of fractures, the form of therapy, time of treatment, etc., a tabular survey has been presented below, on the whole, similar to the one employed by BLUMQUIST and RUDSTRÖM in their recently published paper on this subject.

As will be seen from the survey, plastering as the only method of treatment with or without previous reduction has occurred in only three cases (Nos. 11, 15, 37). The result must be admitted as confirming the nowadays general conception that this method is unsuitable with regard to this kind of fracture. In two of the cases in which no noteworthy shortening of the leg remained after

Case number	Year of treatment	Age in years at time of accident	Time of hospital stay in weeks	Fractural type	Treatment	Shortening at admission	Shortening at discharge	Time of after-examination	The length of the broken leg in rel. to the healthy leg.	Growth in length in cm.
1	1937	5	5	Obl.	W	4	0	Jan. 1943	+ 1.5	1.5
2	"	6	4	Obl.	W	1	0	"	+ 1.7	1.7
3	"	3	6	Obl.	Adh	1	0	"	+ 1	1
4	"	6	9	Tr.	W + Pl	0	+0.3	"	+ 2	1.7
5	"	8	16	Obl.	W+Pl	1	0	March 1943	+ 1.5	1.5
6	"	2	4	Obl.	Adh	1	0	April 1943	0	0
7	1938	3	8	Tr.	Adh	2	0	Jan. 1943	+ 1	1
8	"	5	9	Tr.	Adh+W+OP+Pl	1.5	0	"	+ 2	2
9	"	4	6	Obl.	Adh	1	0.8	March 1943	0	0.8
10	1939	7	11	Tr.	W+OP+Pl	1.5	0	Jan. 1943	+ 1	1
11	"	2	7	Obl.	Pl	0	0.5	"	+ 0.5	1
12	"	3	8	Tr.	Pl+Op+Pl	0	0	"	+ 0.7	0.7
13	"	3	7	Sp.	W+Pl	1	0	"	+ 1	1
14	"	4	9	Obl.	Pl+W+Pl	2	1.5	"	+ 0.3	1.8
15	"	3	5	Sp.	Pl	1	0	Febr. 1943	0	0
16	"	5	8	Obl.	Adh+Op+Pl	1	0	"	+ 1	1
17	"	6	7	Obl.	W+Pl	3	0	"	+ 0.5	0.5
18	"	11	9	Obl.	W+Pl	1	1.2	Jan. 1943	- 1	0.2
19	"	11	8	Obl.	W+Pl	2	0	"	0	0
20	1940	2	4	Sp.	Adh+W+Pl	1	0	"	+ 0.7	0.7
21	"	11	5	Obl.	W	1	0.5	"	+ 0.8	1.3
22	"	6	6	Obl.	W	3	0	"	+ 1	1
23	"	1	5	Sp.	Adh	1	0.5	Febr. 1943	+ 0.5	1
24	"	10	8	Sp.	W+Op+Pl	2	0	Jan. 1943	0	0
25	"	3	5	Obl.	Adh	0.5	1.5	"	+ 0.5	2
26	"	5	7	Tr.	W+Op+Pl	2	+0.3	"	+ 1.5	1.2
27	"	6	8	Sp.	W	2	0	"	+ 1.2	1.2
28	"	7	8	Obl.	W+Pl	1	0.5	Febr. 1943	+ 1	1.5
29	"	7	8	Tr.	W+Op+Pl	2	+0.5	Jan. 1943	+ 1.5	1
30	"	8	9	Sp.	W+Op+Pl	2	0	"	0	0
31	"	11	8	Sp.	W+Pl	3	0.5	"	- 0.5	0
32	1941	1	7	Obl.	Adh+Op+Pl	1	+0.2	"	+ 0.5	0.3
33	"	10	8	Tr.	W+Op+Pl	0	+0.2	"	+ 0.5	0.3
34	"	2	7	Obl.	W+Pl	1	0.5	"	+ 1	1.5
35	"	4	7	Obl.	W+Pl	3	0	"	+ 1	1
36	"	6	6	Obl.	W+Pl	3	0	"	+ 1	1
37	"	2	4	Sp.	Pl	0	1	March 1943	- 0.4	0.6
38	"	12	8	Obl.	W+Pl	3	0	Febr. 1943	+ 0.5	0.5
39	"	11	8	Sp.	W+OP+Pl	5	0	"	+ 0.5	0.5
40	"	2	6	Sp.	Adh+Pl	2	1	"	- 0.5	0.5
41	"	5	9	Sp.	W+Pl	2	0	"	+ 1	1
42	"	6	8	Tr.	W+Pl	4	+0.3	"	+ 1	0.7
43	"	3	5	Sp.	W	2	0	Jan. 1943	+ 1	1
44	"	8	7	Tr.	W+Pl	4	0	"	+ 1	1

Adh: Adhesive traction in vertical suspension.
W: Wire traction through the femoral condyles.
Op: Operative treatment.
Pl: Plaster bandage.
Obl: Oblique fracture.
Sp: Spiral fracture.
Tr: Transverse fracture.

the reduction, dislocation took place with a shortening of the leg in the plaster bandage. In both instances also a slight angular position had occurred in the fracture in the plaster cast. All the fractures were favourable from the point of view of the prognosis with but slightly faulty position from the start. This gave rise to the opinion that there was a chance of obtaining a fully satisfactory result by small means. Two of the cases were spiral fractures, and the third case was a long oblique fracture. The age of the patients kept between 2—3 years, i.e. an age when the weight of the leg and the resistance of the muscles could not have had any injurious effect on the course of healing. The period of treatment was very short in these cases, being on an average 5 weeks.

Thus, although there is reason to disclaim all value of plastering as the only method of treatment in femoral fractures, the method has, on the other hand, been very useful as a supplementary treatment in extension as well as surgery. The plaster has, in these instances, been employed only when the risk of dislocation in the fracture has been the smallest possible. In another two cases the treatment was begun with plaster of Paris, but when the faulty position failed to be corrected within a reasonable space of time by means of this method, soon a more active treatment was resorted to in both instances, viz., wire traction in one case, operation in the other (Nos. 12 and 14).

The primary result of treatment was good in all the cases. No complications have appeared.

The indirect extension in the form of adhesive traction has been employed in six cases (Nos. 3, 6, 7, 9, 23, 25). The adhesive traction has in these instances been applied acc. BARDENHEUER with adhesive strips along the whole of the leg and with only the injured leg in a vertical position. The age of the patients is between 1—4 years, an average of 2.5 years. Thus in spite of the fact that the forces counteracting the extension have been inconsiderable on account of the age of the clientele the effect of the adhesive traction has not been satisfactory. The original shortening of the leg has in no single case exceeded 2 cm and, on an average, kept at approximately 1 cm. Only in two cases has complete correction of the shortening been obtained. In the other cases, the shortening has either only decreased, or, as in one instance, even increased during the extension treatment.

The time of treatment has been comparatively short, viz., on an average 5—7 weeks. However, the cases have been very favour-

able from the point of view of healing. Five of the cases have constituted long, spiral or oblique fractures, and one was a transverse fracture where an exact position was obtained by means of non-surgical reduction. Thus, the prerequisites of a rapid course of union, free from complications, have occurred in all the cases.

In another five cases, the treatment was begun with indirect extension (Nos. 8, 16, 20, 32, 40). In four of these a satisfactory position was not obtained by means of this treatment and a change was made either to wire traction, or operation. In the fifth case, the adhesive traction was later supplemented by plaster of Paris.

The primary result of the treatment has been good in all the cases. No complications in the shape of skin affections owing to the adhesion are mentioned in the records.

The direct extension in the shape of wire traction *ad modum* KIRSCHNER has, during recent years, increasingly superseded the adhesive traction as a method of treatment. In the present material, wire traction will be found to have been employed in more than half the number of cases (Nos. 1, 2, 4, 5, 13, 14, 17, 18, 19, 20, 21, 22, 27, 28, 31, 34, 35, 36, 38, 41, 42, 43, 44). In a further eight cases, wire traction has been used as a supplement to surgical treatment (Nos. 8, 10, 24, 26, 29, 30, 33, 39). Wire traction has been applied as the only treatment in but six cases out of the above-mentioned twenty-three, while in the other cases the traction treatment has either been concluded by the application of plaster, or wire traction has been applied only when the adhesive traction or the plaster has been found ineffective.

The traction has been applied through the distal part of the femur at a safe distance from the epiphysis. The traction has acted in a vertical direction with the hip and knee joints at an angle of 90°. This position has been found very appropriate particularly with regard to children where the absence of splints has facilitated the nursing of the child to a great extent. The age of the patient has varied from 2—12 years, an average of 6.4 years. The fractures have principally been of the spiral or oblique kind, transverse fractures forming exceptions. The primary shortening of the leg has varied between 0—4 cm, being on an average 2.1 cm. The effect of the wire traction has generally been excellent and the faulty position has, in the great majority of cases, been altogether corrected.

The time of treatment has varied between 4—16 weeks with an average time of 8.3 weeks. This period is not inconsiderably

longer than the corresponding period of the fore-mentioned treatment methods. However, the figures may not be regarded as comparable owing to the different character of the fractures.

As mentioned above, direct extension has also been used as a preparatory treatment before operation. By means of this preparatory treatment with wire traction the shortening has either decreased considerably or been entirely corrected, and the operation has been performable under greatly improved auspices. The time which has elapsed from the application of the traction to the operation has varied from one case to another. However, the average time has been approximately 10 days. The traction has even been maintained after operation, which will be further discussed below.

In seventeen of the cases treated with wire traction, this has been supplemented by plastering. The time of the application of the plaster has, naturally, been dependent on the process of the healing. As a rule, after 3—5 weeks the consolidation in the fracture has progressed far enough to permit the application of plaster without any risk of dislocation in the fracture. The plaster has been applied in the shape of a hip plaster from the chest down to the ankles with right angles at the hip and knee joints. The traction has been maintained during the plastering and has only been removed when the plaster of Paris has become quite solid. After a few days, the plaster cast has been cut to a splint up to the knee joint and the functional treatment of this joint has been commenced. The advantage of this supplementary plaster treatment lies particularly in the fact that the knee joint can be mobilized at an earlier phase and, in this way, shorten the period of treatment.

An insignificant infection has occurred only in two cases in the stick opening after the removal of the wire traction. In one case, a small periosteal accumulation on the bone has been ascertained by means of Roentgen at the site of the infection, while the other case gave negative Roentgen findings. The infection rapidly healed and no future damage ensued. No other complications occurred and the results of the treatment were good in all cases.

In the present material, the surgical treatment has been resorted to more often than is usually done. Thus, 11 cases have been operated upon for various reasons (Nos. 8, 10, 12, 16, 24, 26, 29, 30, 32, 33, 39). The indications of operation have been as follows: six of the cases were transverse fractures, and two short oblique fractures with a lateral slipping of the fragments exceeding the

breadth of a bone where traction and non-surgical reduction had failed to give a satisfactory position. Interposition of musculature was found in three of these cases at operation. The three remaining cases were spiral fractures where non-surgical treatment had failed to replace the dislocation. Muscle interposition was observed in one of the cases, while in another a large intermediary fragment was detected which complicated the reduction. Finally, the fracture was found in a third case to lie in a hematoma surrounded by lacerated musculature.

The operation method has been surgical reduction in eight cases with fixation by means of os purum. In the three remaining cases, surgical reduction took place with osteo-synthesis by means of metal wire. Os purum as an osteo-synthetic material has been used in transverse and short oblique fractures exclusively. The method differs to some extent from the usual one and has been previously described in detail by HINDMARSH. At first, it was employed only in transverse fractures proximal to joints, but has later been made use of in all kinds of fractures regarding which a non-surgical procedure has not been successful. The method is based on a combination of traction and surgical treatment. When the shortening of the leg has been remedied, as far as possible, by means of wire traction, operation is performed. After surgical reduction, the fractural ends are fixed with a thin bridge of os purum which is inserted into the medullary cavity. The os purum is square and fairly thin. Consequently, it will not fill the whole of the medullary cavity, nor will it in itself be sufficiently strong to produce the required fixation but must be combined with continued extension treatment. On the other hand, it gives sufficient fixation to prevent dislocation *ad latus et axim*. By means of this procedure, the injurious effect of the new formation of bone is avoided which complete filling of the medullary cavity with foreign fixation material is said to involve. After-treatment was the same as that described above in connection with direct extension. After 1—2 weeks, a hip plaster is applied, and the traction is removed one or two days later. The primary result of this method was excellent in all cases and complete correction of the faulty position was obtained. All the three cases where osteo-synthesis with metal wire was used have also united without complications and with good primary results of treatment.

The time of treatment with regard to the operated cases has been, on an average, 8.3 weeks, i.e. the same figure as in the cases

treated with direct extension. As a rule, the longer period of treatment in surgical cases has been pointed out as a drawback. However, this has not been confirmed in the present material. In addition, a certain period has generally elapsed before the operation is undertaken, being in this material an average of 10 days. Thus, the course of the healing is hindered during a corresponding period of time. Accordingly, judging from the present material, operation does not in itself involve any prolongation of the period of treatment.

All the above-mentioned 44 cases have been subjected to after-examination within a space of time varying from 1—5 years after the discharge from hospital. At the after-examination, an external measuring of the length of the leg was first performed and the mobility of hip and knee joints was tested. Furthermore, the circumference of the legs was measured in order to ascertain possible atrophy, and the spinal column was examined with regard to the possible occurrence of scoliosis or other deformities of carriage. Finally, a Roentgen examination was performed of both legs with roentgenological measuring of the length of the legs. The roentgenological measuring was done in order to check the increased growth in length which may take place, as is known, in the fractured leg in children during the time after the trauma. Accordingly, detailed measuring was performed of the shortening and the diastasis, respectively, which remained on the last Roentgen picture taken during the stay at the hospital. Then the result of this measurement was compared with the difference in length between the two legs which was found at the roentgenological measuring at the after-examination. Certain sources of error are inherent in this method in spite of the care observed in its execution, as mentioned by BLOMQUIST and RUDSTRÖM. The Roentgen examination itself constitutes one source of error, i.e. above all in older children where the length of the legs is such that one plate does not suffice, two plates taken with the use of an indicator being required. Further, LEVANDER's statement that the legs may vary in length from the beginning may be added. Finally, a shortening of the fractured leg may take place after the last Roentgen picture when weight-bearing has begun before the discharge from the hospital. However, these sources of error are in all likelihood, not of any marked significance and the erroneous measuring, at any rate, is probably only a matter of a few millimetres.

The after-examination has, on the whole, disclosed very good

results of treatment. Only two patients have returned of their own accord to the hospital owing to slight troubles after the discharge. In one case, a boy of 8 years was concerned who had been operated upon two years earlier for a transverse fracture with reduction and osteo-synthesis by means of os purum. He had been altogether free from troubles after his discharge but had now for a month, in connection with gymnastics, complained of pains in one groin and dragged his leg behind him. An examination revealed the operated leg to be $1\frac{1}{2}$ cm longer than the other leg, but otherwise no objective symptoms were ascertained. The other case concerned a girl of 10 years who had been treated three years earlier with wire traction in the case of a left-sided transverse fracture. She now stated that she had noticed, on and off, lock symptoms in the left knee which had, in addition become swollen. Moreover, this case showed a lengthening of the left leg of $1\frac{1}{2}$ cm but otherwise no objective symptoms. A Roentgen examination of the knee joint was negative too.

In another three cases, the patients reported slight troubles, such as a feeling of tiredness in the leg after heavy exertion. Two of these cases revealed a lengthening of the fractured leg of 1 and 2 cm, respectively.

All the other cases were, subjectively speaking, altogether free from troubles. The objective examinations, with no exceptions, showed free mobility in the knee and hip joints. No atrophy of the musculature has been ascertainable. In two cases with a distinct lengthening of one leg, a slight scoliosis was found in the lumbar spine which was easily repaired by means of a corresponding increase of the length of the other leg by means of elevation of the heel. Otherwise no spinal deformities were met with. In the majority of cases, the external measuring revealed differences in the length of the legs. The values obtained in this way conformed, in several instances, badly with those established at the Roentgen measurement. The difference in length consisted of a lengthening of the fractured leg with the exception of three cases. These three showed a remaining shortening of the leg. No pseudarthrosis occurred in any of the cases.

At a Roentgen examination but a year later, only an insignificant deformity was found to remain of the femur at the site of the fracture. When an after-examination was performed after not more than 4—5 years after the stay at the hospital, in the majority of the cases no trace of the fracture was ascertainable by means

of Roentgen. As far as the os purum bridge was concerned, an after-examination of the oesto-synthetic material disclosed the first signs of fragmentary resorption, becoming sclerotic after one year the resorption process being completed after two years. The cerclage fibres were embedded in the bone in all cases. No atrophy of the leg was ascertainable owing to the cerclage.

Ever since OLLIER in 1867 established the occurrence of an increased growth in length of the leg in children after fractures, this has formed the subject of investigations by a number of authors. It has been proved that even fairly pronounced shortenings have been neutralized within a few years by the growth of the leg. A similar growth has been obtained also by experimental stimulation of the bone by chemical means foreign bodies etc. Even OLLIER regarded the cause of this phenomenon to be the increased afflux of blood which was the result of the stimulation process of the leg connected with the healing. In spite of the fact that some authors have propounded the viewpoint that this process was of a compensatory nature and restricted to the site of the fracture later investigations by inter alia LEVANDER have clearly demonstrated that the cause of the increased growth in length is above all to be found in a stimulation with increased afflux of blood to the epiphysis. Moreover it has been ascertainable that mainly the distal part of the epiphysis is engaged in the added growth with regard to femoral fractures (BERGMAN, SILVERSKIÖLD, BLOMQUIST, RUDSTRÖM).

The growth in length has varied most considerably from one case to another but the average value is among all the authors approximately 1 cm.

In the present material an increased growth in length has been ascertainable in 38 cases (86 per cent). The average value of the growth in length is 0.9 cm. The values have otherwise varied between 0—2 cm. The average value of the growth in length has been found to vary in the different age groups also with regard to this material. The natural extension periods of the child set in, of course during the first year of life and at the beginning of the school age. Theoretically speaking the growth in length should, accordingly, be greatest in these very age groups. In the following table, the biggest values of growth in length will be found during the age of 4—8 years while the values of the first years of life and the age of 10—12 years are low. No cases under one year of age are included in the present material. Owing to the smallness of the

material. all the values must, naturally, be accepted with the greatest caution. However, the figures conform, on the whole, with corresponding values given by other authors, a fact which speaks in favour of their accuracy.

Age group	Number of cases	Average value of growth in length
0—2 years	4	0.6 cm
2—4 "	12	0.9 "
4—6 "	10	1.2 "
6—8 "	8	1.1 "
8—10 "	3	0.9 "
10—12 "	7	0.4 "

No case in which an increase of the growth in length has not occurred has been found in the age group 4—6 years, one case has been noted in the age group 6—8 years, two in the age group 2—4 years and not less than three in the age group 10—12 years. From this it will be seen that therapeutic treatment cannot with certainty take into account an increase in the growth in length in all cases, and, above all, not in the youngest and oldest age groups in children.

The hypothesis of an increased growth in length, as due to the hyperemia in the leg connected with the healing process, forms the basis of an attempt, on the part of several authors, to establish an interrelation-ship between the growth in length and the amount of callus. From a theoretical point of view, the callus formation should, of course, involve an increased supply of blood, like every other process of new formation. Thus, the degree of hyperemia and with it the growth in length should be proportional to the extent of the callus formation. On the other hand, the callus formation is dependent with regard to its extent on the nature of the fracture, the degree of faulty position, etc. Experience has, in fact, shown that a fracture with large contacting surfaces between the fractural ends, and in a correct position, causes the smallest amount of callus. Fractures of this kind should, consequently, entail a minimum increase in growth.

As a matter of course, this restricted material will not permit the demonstration of any convincing proof of the accuracy of this theory in practice. Without doubt, also other factors play a part in this connection. However, the result of this after-examination must, on the whole, be said to confirm the above-mentioned theory.

Thus, when 9 cases in which little or no growth in length has taken place during the after-course are subjected to examination, the following observations will be made.

8 of these 9 cases were long spiral and oblique fractures and only one was a transverse fracture. In all cases, an exact position of the fracture was obtained, primarily or after but a short time, in 4 instances after operation.

On the other hand, when the 9 cases are observed in which a growth in length exceeds 1.5 cm, 7 of them will be found to constitute oblique fractures and 3 transverse fractures. In 5 of these cases, a shortening of the leg remained during the whole of the healing process, and in 1 case a diastasis in the fracture. In the remaining 3 cases, slight dislocations *ad latus* and an angular position in the fracture remained. Surgical reduction had been performed in only one of these cases.

It has also been suggested that the growth in length should be due to the method of treatment. The present material offers no support for this theory. Assuming that the growth in length is dependent on the exactness of the reduction, the surgical treatment should then give rise to the least growth in length. However, in this connection, the stimulation factor involved in the operation itself and in the fixation material should be borne in mind. It would, probably, be generalizing too much to look upon the growth in length as due to the method of treatment, irrespectively of the position of the fracture, the course of the healing, etc. It appears more likely that a method which causes an exact position in the fracture by gentle means and within a short time will also give rise to the least stimulation of the leg and, accordingly, also to the smallest increase in length.

Summing up, it may be said that the prognosis of femoral fractures in children is good irrespectively of the method of treatment. Broadly speaking, the choice in the method of treatment in children may be viewed in the same light as with regard to adults. Adhesive traction may be employed to advantage only at a younger age. Wire traction may conveniently be applied also to very small children. As in the case of adults, the aim of the treatment should be to attain, as far as possible, an exact anatomical position in the fracture. Surgical treatment should, therefore, be resorted to in cases where a conservative treatment fails to produce a satisfactory position within a reasonable space of time. As to the therapeutical measures, a shortening in the fracture should not a priori

be supposed to be counterbalanced by an increased growth in the length of the leg during the after-course. The increased growth in length is not a general occurrence but dependent on a number of different factors, such as the age of the child, the nature of the fracture, the course of the union, etc.

Summary.

The present paper is based on a material comprising 44 cases which have been treated for femoral fractures at Kronprinsessan Lovisas Barnsjukhus during the years 1937—1941. 34 of these cases were boys and 10 girls. All the cases have been subjected to after-examination during the spring of 1943. The patients were at an age of 1—12 years.

The treatment has consisted of plaster bandages, indirect and direct extension, and surgical reduction with or without fixation by means of osteo-synthetic material. The plaster bandage is shown to lack the pre-requisites of causing good fixation in fractures of this kind. Indirect extension with adhesive traction gives good results only in the younger ages. Direct extension with wire traction has been applied to advantage also on very small children. Furthermore, no conspicuous risk of complications in connection with this treatment seems to occur, provided the necessary precautions have been observed. In the majority of cases, extension treatment has been supplemented by plaster bandages during the after-course. Surgical treatment has been employed in 11 cases. In 8 of these surgical cases, osteo-synthesis with os purum has been performed and clereclage with metal wire in the other three. In osteo-synthesis with os purum a very thin bridge has been used which has not entirely filled the medullary cavity. Therefore, the treatment has had to be supplemented by wire traction. The advantage of this method has been good fixation *ad axim et latus* without any risk of disturbing the new formation of bone by the filling of the whole medullary cavity.

The after-examination has disclosed very good results. Only two patients have of their own accord returned owing to slight troubles. Another two have complained at the after-examination of insignificant troubles after exertion. An increased growth in length of the fractured leg was ascertained in 38 cases. The growth in length varied between 0—2 cm and was greatest at the age of

4—8 years. The result of the after-examination is considered to bear out the theory of a dependence of the growth in length of the leg on the amount of callus and, indirectly, on the nature of the fracture and the exactness of the reduction.

Zusammenfassung.

Der Aufsatz gründet sich auf das Material von insgesamt 44 Fällen, die in den Jahren 1937—41 in der Krankenpfleganstalt der Kronprinzessin Lovisa wegen Femurfrakturen behandelt wurden. Von diesen waren 34 Jungen und 10 Mädchen. Sämtliche Fälle sind im Frühjahr 1943 nachuntersucht worden. Die Patienten waren im Alter von 1—12 Jahren.

Die Behandlung hat in Gipsbandage, indirekter und direkter Extension sowie blutiger Reposition mit oder ohne Fixation mit Osteosynthesmaterial bestanden. Es zeigte sich, dass der Gipsverband keine Voraussetzungen für eine gute Fixation bei Frakturen dieser Art hat. Indirekte Extensionsbehandlung mittels Pflasterstreckverband gibt nur im zartesten Alter ein gutes Resultat. Direkte Extension mittels Drahtstreckverband ist auch bei sehr kleinen Kindern mit Erfolg angewendet worden, und es scheint kein grösseres Risiko für Komplikationen bei dieser Behandlung vorzuliegen, wenn nur die nötige Vorsicht beobachtet wird. Die Streckbehandlung ist in den meisten Fällen im Laufe der Behandlung mit Gipsverband ergänzt worden. Operative Behandlung erfolgte in 11 Fällen. In acht von diesen hat man Osteosynthes mit *Os purum* gemacht, in den übrigen drei mit Cerclage aus Metallfäden. Bei Osteosynthes mit *Os purum* wurde ein sehr dünner Knochenspan verwendet, der die Markhöhle nicht ganz ausfüllte. Die Behandlung hat daher mit Drahtstreckverband ergänzt werden müssen. Der Vorteil davon ist eine gute Fixation *ad axim et latus* ohne Risiko für gestörte Knochenneubildung (Ossifikation) durch Ausfüllung der ganzen Markhöhle gewesen.

Die Nachuntersuchung hat ein gutes Ergebnis gezeigt. Nur zwei Patienten sind aus eigenem Antriebe wegen leichterer Beschwerden zurückgekommen, und weitere zwei klagten bei der Nachuntersuchung über leichte Beschwerden bei Anstrengung.

Ein erhöhtes Wachstum der Länge des frakturierten Beines wurde in 38 Fällen festgestellt. Die Längenzunahme wechselte zwischen 0—2 cm und war im Alter von 4—8 Jahren am grössten.

Das Ergebnis der Nachuntersuchung wird als Stütze für die Theorie über die Abhängigkeit der Längenzunahme von der Menge des Kallus und indirekt von der Art der Fraktur und der Exaktheit der Reposition erachtet.

Résumé.

Cette composition se base sur un matériel de 44 cas en total qui pendant les années 1937—41 ont été soignés de la fracture fémorale au Kronprinsessan Lovisas Vårdanstalt. 34 de ces cas étaient des garçons et 10 en étaient des filles. Tous les cas ont été ré-examinés de nouveau au printemps 1943. L'âge des malades variait entre 1—12 ans.

Le traitement a consisté de bandage de plâtre, de l'extension directe et indirecte, et ensuite de la réduction chirurgicale avec ou sans fixation à l'aide de matériel d'ostéo-synthèse. Il en résulte, que le bandage de plâtre n'a pas des qualités à assurer une bonne fixation aux fractures de ce genre. Le traitement d'extension indirecte à l'aide d'une traction adhésive ne donne de bon résultat que dans les âges les plus jeunes. L'extension directe à l'aide d'une traction de fil a été employé avec succès même chez les enfants très petits et, si une précaution nécessaire est observée, ne semble pas donner lieu au grands risques aux complications suivant de ce traitement. Dans la plupart des cas, le traitement d'extension fut complété de bandage de plâtre dans le cours postopératif. Le traitement opératif fut employé dans 11 cas. Dans 8 de ces cas on a fait ostéo-synthèse à l'aide d'os purum, dans les 3 restant à l'aide de cerclage de fil de métal; à l'ostéo-synthèse à l'aide d'os purum un pont très fin qui n'a pas complètement rempli la cavité moelleuse fut appliqué. Par conséquent, il était nécessaire de compléter le traitement d'une traction de fil. L'avantage en a été une bonne fixation ad axim et latus sans risque d'une nouvelle formation d'os interrompue par le remplissage de la cavité moelleuse entière.

La ré-examination a donné un résultat satisfaisant. Pour des peines légères, deux malades seulement ont retourné d'eux-mêmes et, au cours de la ré-examination, deux autres se sont plaints des peines légères que leur causait l'effort. Un accroissement de longueur augmenté de la jambe fracturée fut constaté dans 38 cas. Cet accroissement varia entre 0—2 ans et fut plus accentué dans l'âge 4—8 ans. Le résultat de cette ré-examination paraît supporter

la théorie, que l'accroissement de longueur de la jambe dépend de la quantité de cal et, indirectement, du genre de la fracture et de l'exactitude de la réduction.

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Till redaktionen insända böcker;

Prof. S. GIL VERNET: Patologia Urogenital. Tomo I. Cancer
de Prostata. Editorial Miguel Servet. Barcelona. 1944.

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